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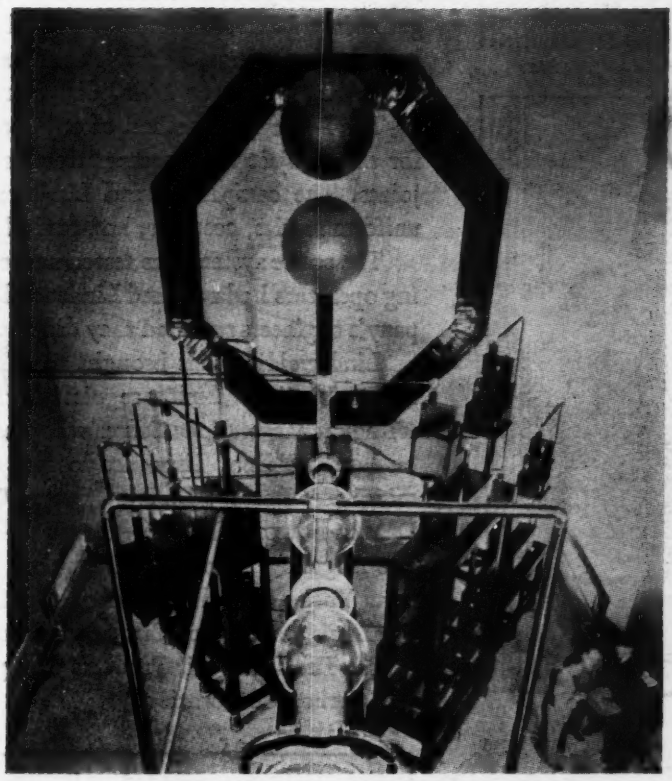

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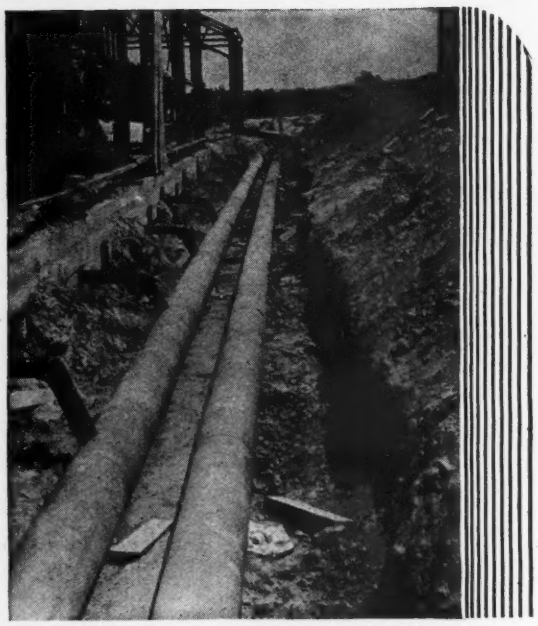
IN THIS ISSUE

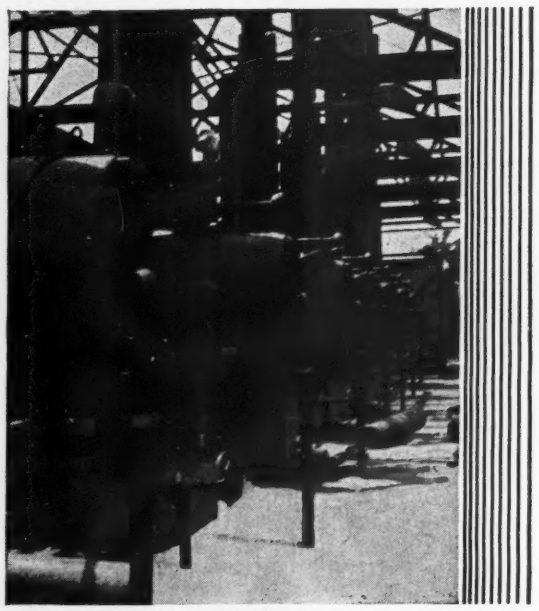
Hobbies

British Broadcasting

MASSACHUSETTS INSTITUTE OF TECHNOLOGY



This Lindewelded pipe can be buried and forgotten



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*** Lindewelding is a new method of oxy-acetylene welding developed by the Linde engineering and research organizations. This method requires less oxygen, less acetylene and less welding rod. Welds can be completed in less time. Yet Lindewelding involves only a special flame adjustment and a "back-hand" technique, together with Oxweld No. 24 Lindeweld Process Welding Rod. When circumstances permit, the Multi-Flame Lindeweld Head can be used. This will further increase the speed of Lindewelding. It costs only $7.75. On pipe line construction Lindewelding is consistently saving 15 to 40 per cent in welding time, rods and gases.**

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OUR AUTHORS

VANNEVAR BUSH who wrote about HOBBIES for this issue received his M.S. degree from Tufts College in 1913. He has been active in engineering and educational fields ever since. In 1913 he became connected with the test department of the General Electric Co. In 1914 he was with inspection department of the United States Navy. From 1914 to 1916 he was back at Tufts College, first as mathematics instructor, and later as Assistant Professor of Electrical Engineering. He received his Eng.D. from M.I.T. and Harvard in 1916. During the War Years he did research work on submarine detection for the U. S. Navy. At the same time and until 1922 he was consulting engineer for the American Radio and Research Corp. He has been connected with the Spencer Thermostat Co. and the Raytheon Manufacturing Co. since their inception. In 1919 he was made Associate Professor of Electric Power Transmission at M.I.T. In '23 he became full professor and was also made Dean of Engineering. He was elected Vice-President of the Institute in 1932.

P. P. ECKERSLEY, author of our article on BRITISH BROADCASTING, has been an inventor of ideas ever since he first became interested in wireless in 1908. While he was connected with the Marconi Company he designed the first wireless telephone ground station for the London Terminal Airport. Later, as chief engineer of the British Broadcasting Corporation, he was responsible for the technical tenets which are even today used as the basis of monopoly broadcasting. The knowledge gained from his studies enabled him to frame the Regional Scheme of broadcasting, which was begun before he left the B.B.C. Since 1929, when he left B.B.C., Eckersley has been investigating the possibilities of wire broadcasting, which he believes tends to make broadcasting more flexible, and more like the American System, which he so much admires.

MR. C. E. WESTON of Newbury, Michigan, who wrote on the subject of CHROMIUM was graduated from the Michigan College of Mining and Technology in the class of '27 with the degree of Bachelor of Mining Engineering. He later decided to take a Master's degree at the University of Michigan. He received this degree in 1932. The following summer he worked with the Union Carbide and Carbon Corporation on their exhibit at the World's Fair in Chicago, and was later transferred to the New York Office of the Electro Metallurgical Company, a subsidiary of the Corporation, in the fall after the close of the fair.

RUDOLPH P. MILLER, author of our BUILDING COLLAPSES' article, is a New York consulting Engineer, who was Superintendent of Buildings for the Borough of Manhattan for over six years. He studied Civil Engineering at Columbia University and has received an honorary Master of Science degree from that institution. In the course of his interesting career he has held many executive positions in public building organizations. At present he is actively engaged in committee work with the American Society for Testing Materials.

CHARLES K. EVERETT, author of our article on COTTON, is the Manager of the New Uses Section, of the Cotton-Textile Institute in New York City, whose staff he joined in 1929. Mr. Everett's position is a fascinating one carrying the responsibility for the development of both new and established uses for cotton.

He is a graduate of Dartmouth College in the class of 1916 and prior to taking charge of the Institute's promotional work, held important merchandising posts with Lord & Taylor, New York and other well-known retail organizations.

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REMEMBER YOUR DIVIDEND

OUR COVER

THE apparatus pictured on the cover is not the entry of an ingenious freshman in T. E. N.'s Brainstorm Contest; nor is it the result of an all-night conference between Professor Van de Graaff and the Institute's two glass blowers, Mr. Bautze and Mr. Ryan. It is a weapon of medical science—the world's largest deep therapy X-ray unit at the Mercy Hospital Institute in Chicago, a device for destroying cancerous growth in humans.

The generally accepted theory of the still mysterious disease is that a cancer seems to consist of a group of "wild" cells, possibly all arising from a single cell which has somehow undergone a change, escaped from the regimented control in which all normal cells are kept by the body, and begun reproducing at a furious rate at the expense and to the detriment of other cells.

The multiplying cells steal food from healthy cells in the vicinity; they crowd the others out and give off poisons that kill them. Moreover, most rapidly growing cancers, like mobs, have no internal organization; they may destroy not only their surroundings but part of themselves. A large cancer often breaks down, decomposing on the inside while the outer cells, still well nourished in the vicinity of healthy tissue, continue growing. Small fragments of the cancer break off, travel through the blood or lymph streams, and establish secondary cancers elsewhere.

When the cancerous growth is discovered soon enough, it may be removed entirely by surgery. When it cannot be cut out, it may sometimes be destroyed by radiation, for cancer-cells seem to be less stable, and less able to stand doses of killing radiation, than normal cells. X-rays will kill all kinds of cells if they are long exposed, but the cancer-cells die first. The technique of the radiologist is to expose the tissue just long enough to kill the cancer, but not injure the healthy flesh.

The chief mystery is: what causes the original cancer-cell to become wild? A widely-held theory blames local irritation: for example, a cancer of the lip might be caused by a jagged tooth, or pressure from a pipe stem. There is considerable evidence that some cancers do arise from such causes.

But recently cancers have been experimentally induced in laboratory animals by painting the skin with certain tar products, indicating a possible chemical origin for the disease. This discovery is particularly significant because tar compounds that cause experimental cancer are related chemically to substances always found in healthy bodies, including cholesterol, a constituent of bile, and some of the hormones.

In order to effect a cure cancer must be treated early, before its growth becomes so large as to be inoperable. Moreover, cancers in many parts of the body are difficult or impossible to reach; the types most amenable to surgical or radiological treatment are those of the skin, mouth, breast and the more superficial body cavities.

The burden of the teaching of cancer societies is that cancer should be diagnosed early. But it is a fact that cancer, in its early stages, seldom is painful; usually the victim does not know that anything is seriously wrong with him until the cancer has reached an inoperable stage.

What is needed, physicians say, is a simple, direct and accurate method of diagnosing cancer—possibly a skin or blood test that will give unfailing warning of cancer no matter where it is located in the body. Although several such tests have been proposed, none, as yet, has received the approval of the medical profession as sufficiently reliable and easy of application for practical use.

Dr. Frederick L. Hoffman has made public this rather alarming increasing tread of deaths due to cancer:

Year	Deaths per 100,000
1924	111.8
1933	118.3
1934	122.9

Dr. Hoffman's figures were obtained from 165 American cities.

There is no accepted explanation of the recent rise in cancer deaths but some commentators have asserted that the increase is more statistical than real. Physicians report more deaths from cancer than formerly, partly because diagnosis is better.

Another suggestion is that cancer is particularly a disease of later life. Recent success in controlling contagious diseases has increased the average length of life; hence the death-rate from cancer should be expected to increase.

—The Literary Digest

T. E. N.'s BRAINSTORM CONTEST

BEFORE the frosh are told to forget everything they learned at high school, and before their minds are slowly but so certainly guided to think, breathe, and believe engineering by our distinguished and persistent instructing staff, T. E. N. wants to investigate their minds. The managing board believes that this is the first time an attempt is made to furnish an insight of the brains of the cream of the high and prep schools from all over the world, *just before they are so effectively altered!*

For the best conception of some machine, process, or gadget by a freshman resulting from his own thought and ingenuity, T. E. N. will award a four-year subscription plus a cash prize of two dollars.

A second, third, and five fourth prizes will be respectively a three, two, and five one year subscriptions.

If any of the winners are already subscribers to T. E. N., the prize subscription will commence at the expiration of the paid subscription.

THE RULES:

1. Any freshman in attendance at the Institute for his first term is eligible.

2. The idea must be presented by means of a neat, but not elaborate, simple inked drawing, and a typewritten explanation of not more than 300 words.

3. The paper to be used for the drawing and explanation must be 8½″ x 11″.

4. Papers must be submitted on or before 5 p.m. Tuesday, October 15th to the managing board of T. E. N., Walker Memorial.

5. Each entry must be accompanied by an entry blank, which may be obtained by any freshman wearing a freshman tie when he obtains his T. E. N.

6. The decision of the managing board will be final. In case of ties, duplicate awards will be made.

The winning entry will be published in full in the next issue of T. E. N.

THE TECH ENGINEERING NEWS

NOVEMBER, 1935
VOLUME XVI
NUMBER 5

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DORIAN SHAININ
General Manager
BRENTON W. LOWE
Editor-in-Chief
ROBERT E. WILLIAMS, Jr.
Business Manager

Technique

THE BIG NOISE

Professional Men Should Have

HOBBIES

for Necessary Relaxation

By *VANNEVAR BUSH*
Dean of Engineering

A HOBBY is a secondary, systematic activity, spontaneously pursued and not carried on for economic gain. A man has a hobby when, in his hours of leisure, he customarily turns with zest to some freely preferred form of play, or of work regarded as play, finding therein release from the stress of necessity or obligation, an interest sufficient to yield diversion, and a chance to excel for the sake of excellence.

The hobby may be of fancied or real benefit to the individual; but if this benefit is direct and financial it ceases to be a hobby in the true sense. Of course, many men carry on their vocations for other reasons than economic gain; some because they do not need the income. These persons, however, will continue to regard their vocations as work; they may even take pains to emphasize the fact that they are workers, though not forced to be such by economic pressure.

Finally, a hobby is always systematic, at least in the sense of being pursued somewhat assiduously, or at intervals over a considerable period. Cleaning the cellar is not proper material for a hobby, first because it is seldom done spontaneously, and second, because it lacks the element of continuity.

The reasons people give for their hobbies are usually the result of rationalization. Actually, they arise from a wide variety of primary instincts or urges, and their true source is seldom recognized or admitted. The basis for some is exceedingly obscure.

It is easy to grasp, and admire, the urge which causes a man whose work is humdrum to take to a creative hobby. All of us have the desire to create new and useful or beautiful things. Some are so fortunate that the main effort of their lives is directed to this end. But many who have the urge intensely can exercise it ("exercise" is a much better word than "satisfy") only in a secondary way. While this urge is usually joined with some desire for acclaim, the usual gross discrepancy between the amount of effort and the amount of recognition, and devoted continuation in the activity in spite of this discrepancy, shows that the principal motivation is the creative instinct.

There is another closely allied urge which results in constructive or creative hobbies—the urge to do some one thing well. The salesman who is a cabinetmaker in the long winter evenings derives great satisfaction from making a perfect wooden joint, not simply because it will be admired, although that may have its effect, but rather because he can admire it himself. There is nothing new about the joint; he is entirely content to follow rules and make an accepted form. But a perfect joint, one that could not be improved upon by a master, is glorious balm for a mind tired of trivial contacts; it is a powerful palliative for an inferiority complex. For that he will work days and months; and he is dead right.

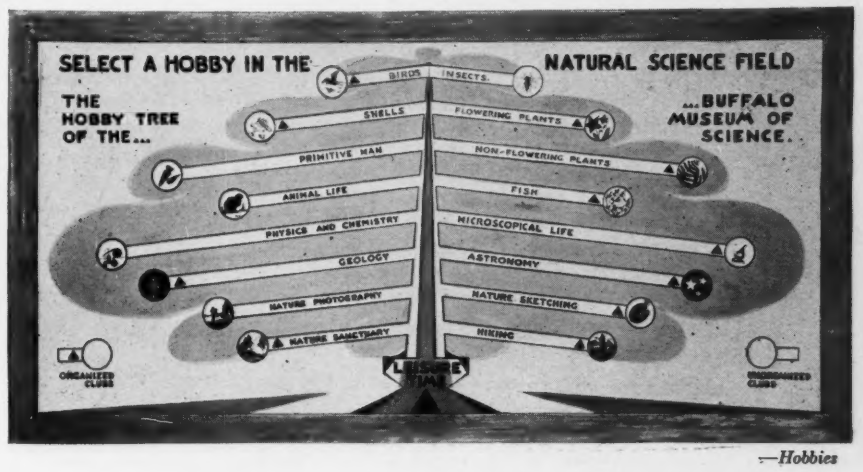
But how about the collector? Apparently a section of the human race has a primary instinct, similar to that of the pack rat, or some crows, of collection for its own sake. Such strange things are collected that one suspects an urge for unique individuality, the white stone of Scripture; but this is somewhat negatived by the many—such as the philatelists—who collect much the same things.

This collecting hobby is usually highly rationalized. The hobby-riders seek to find justification for their pursuit by arguing that the collections are or may be valuable, or that the world needs them for the purposes of accurate history. The joy of discovery is present, of course, but it hardly seems dominant. The apparent explanation of it all is that collectors are just persons supplied with a peculiar combination of genes, which causes them to collect, and they can't help it.

Many hobbies arise simply because the play instinct of youth persists. This has its fine aspects; but adult play is apt to be over-intense, and there are few indeed who maintain a pure form of enjoyment of play for its own sake. Just because a hobby takes the form of a game is no proof that it is pursued by reason of a play instinct that has been preserved beyond its normal term. It may be an expression of a will to dominate, or of a yearning for notoriety; or it may even not be a hobby at all, but just a way of selling insurance.

And yet play, when supervised, so to speak, by common sense, and moderated by a sense of humor, may be regarded as the basis of hobbies in general. For play springs from the vital force that makes activity more pleasurable than quiescence; and though in a sense it is blind, like the drive of life itself, it shadows forth the past, as in fleeting racial memories. Spontaneous play is often reminiscent of the serious strifes and goals of days more primitive than the present.

Hobbies seldom are chosen; they usually just happen. And this is a bit unfortunate, for nearly every man sorely needs hobbies in some form, while desires and aptitudes differ. Hobbies offer a safety-valve for legitimate but inhibited instincts. They make for a saner life, therefore, and they dull the keen edge of disappointment and disillusionment. For these reasons, it is too bad that they cannot be prescribed,



". . . a range of alleys and paths that have seldom been entered."
A Buffalo Museum of Science Poster.

—*Hobbies*

so as to fit each individual case. Sometimes, of course, they *are* prescribed, and psychiatrists put people to work fitting together little wooden blocks. Nevertheless, spontaneity is of the essence of hobbies, and they resist artificial stimulation.

In spite of this fact, there are a few things that seem obvious in regard to the cultivation of hobbies; and perhaps the mere recognition of the fact that they have diverse relationships to one's ordinary activities in life may cause a strong one to sprout in fertile and favorable soil. Certainly it appears possible to label some combinations as plumb foolish. Opinion even on this will differ, so that all that can be hoped for, as in the verdict of insanity, is that there will be a determining majority.

The physical scientist or mathematician who plays chess as an avocation is a claimant for honors. Sailors-on-leave and swanboats in the Boston Public Garden furnish a relatively rational combination. It would seem more reasonable to use various portions of the brain in alternation. The mechanic at the bench who builds radio sets in his spare time at least introduces the, to him, novel experimental approach.

This does not mean, of course, that skills and knowledge which are acquired in a vocation should not be used in connection with a hobby. In fact, they often make possible rapid progress in interesting fields. They should, however, be mere aids, if the full benefit of the hobby is to be obtained, as this demands diversification of methods as well as of interests.

The main point, in an essay in this particular field, is what sort of hobbies are of true value to the technical man, and what is the desirable attitude in which to approach them? On this subject the author's convictions are somewhat unorthodox, and this is perhaps the reason for his writing an essay at all.

The primary activities of technical men differ so widely —ranging from executive functions to research—that no general scheme of recommendations is possible, nor would it be followed if given. Yet, there are aspects of the subject that are seldom discussed, and these may be helpful to those just starting professional careers who have not, yet, developed a settled hobby philosophy of their own.

Hobbies are serious affairs, and yet should not be taken over-seriously. This paradox arises by reason of the very nature of a hobby. Primarily it should give relief, and exercise mental muscles that would otherwise atrophy. It is imperative that time and means be found to relax, for too intense continuous application to any pursuit will ultimately cause any man but a man of iron to crack or grow stale. And, for this very reason, the intense hobby may be worse than none.

There is much to be said for the privilege of being a dilettante at one's hobbies, when they have the role of relief outlets. The professional man, in his primary activities, is forced to adopt a rigorous self-discipline if he would be successful. He cannot tolerate any sloppy or superficial work on his own part, any more than he can on the part of his subordinates. Whatever he starts, he must finish, even if he grit his teeth and work with an intensity and determination which he knows to be dangerous to his good nature if not to his good health. If he is normal, and if his work is congenial—which usually means simply that it is reasonably commensurate with his capabilities—he will in fact derive much of pleasure and satisfaction from his thoroughness, his precision, his dogged determination, in the primary affairs of life.

But when he turns to his hobbies, then he can taste the joys of the dabbler to his heart's content and without introspective reproach. In fact, the greater portion of his relief will come in throwing off temporarily those rigid controls which are so necessary if he is to compete successfully in an intense world. He can skim the cream of an interest, and blithely ignore any part of a subject which seems drab. He can putter with a diversion, and drop it half-grasped. After chopping at his vocational woodpile, he can relax into his avocational hammock and watch the clouds drift across the sky.

Is there time for hobbies in a busy modern life? Plenty! This will, no doubt, be vigorously denied, especially by technical students. It cannot, perhaps, be substantiated by statistical evidence or argument, although it might be established by laboratory work in psychology, especially in the field of fatigue studies; nevertheless, it is true. The creative man —and every scientist and engineer is such, whether in or out of the research laboratory—accomplishes his real results in a very small fraction of the whole time he actually devotes to his professional work. As Dr. George Sarton says in one of his lectures:

"One may have the illusion that one sees a man working, and this is truly possible for the lowest kind of work, but can we see him think? We may watch a physicist in his laboratory, but this will not help us very much. When he seems most busy, it is possible that he does nothing of importance. For aught we know he may be doing his best work while shaving or playing with a little dog."

It is not too much to assert that men who are making the great advances in business or science accomplish ninety per cent. of their total contribution to the world's progress in ten per cent. of their time.

This idea is sometimes pushed to the extreme conclusion that a man need work but ten per cent. of his time, if he is engaged in creative activity. Some artists and writers are especially content to operate only when the Muse is at large; which often means when they are not too all-fired lazy. The result is that they accomplish nine per cent of their capabilities in one per cent of their time. It is very much like the growing of prize roses; only a few are worth exhibiting, but it is not possible to grow those few only.

Yet, for the creative man, so much depends upon being at top form, at least once in a while, that it pays to ease the pressure often. Clipping a bit of time to devote to a hobby, provided it raises the tone of the remainder of the time given to work, may well increase production notably, in quality no less than quantity. Many men treat their minds with a lack of consideration that they would not tolerate in handling a work horse, let alone a racer. A reasonable balance leaves time for hobbies in the busiest of lives; in fact, the busier the life, the more likely are hobbies to be essential to maximum accomplishment.

There are so many interesting things on the earth, often in the humblest area, that there is no lack of hobby material. So it is well to have a myriad of hobbies, taking them up and dropping them at will, in order that a fine one may always be at hand. Some require apparatus and gear, or certain seasons, and others nothing but leisure and writing or drawing material. Having many, one can be an opportunist, and so avoid that complete vacuum which is a breeder of discontent.

(*Continued on page 105*)

—Hobbies

Early education in hobbies to provide an interesting diversification from one's arduous tasks in later life.

THE BRITISH REGIONAL SCHEME *for a* NATIONAL BROADCASTING SERVICE

By P. P. ECKERSLEY
Former Chief Engineer of the B. B. C.

Character of British Broadcasting

BRITISH Broadcasting is nationalized. A body called the British Broadcasting Corporation, or more generally, the B.B.C., is given authority, under a Royal Charter, to conduct the service and provide programs "to the satisfaction of the Post Master General." A non-executive Board of Governors appointed by the Government is responsible for the conduct of the service. The existing chief executive was also appointed by the Government and is responsible to the Board of Governors for the administration of the organization which frames and produces the programs, and maintains and designs the apparatus necessary for their nation-wide dissemination.

The necessary funds are paid to the Corporation by the Government. The Government taxes each listener by making him pay, annually, a fee of about two dollars for permission to listen to the programs. Of the two dollars per annum per listener paid to the Government, about one dollar is paid to the B.B.C., the balance being allocated partly to the cost of collection and mostly as national revenue.

There are roughly 7,000,000 licensed listeners in Great Britain to-day.

The Technical Foundations of Public Service Broadcasting

The technical foundations of public service broadcasting are radically different from those which support advertising broadcasting. Any comparisons between American and British broadcasting, whether they concern programs or technique, must recognize this fact.

The technical problems, once it is agreed that a given service is necessary, are the same; the interpretation of the requirements of service are, however, different according to whether the listener pays for his service or gets it without direct payment.

The determining factor in limiting radio broadcasting facility, whether constituted under public service or advertising stimulus, is the limitation of the number of available channels or wavelengths.

The public service technician must, with a limited number of channels, study first how to give an adequate service to to all those who pay for the service; his counterpart, designing stations to distribute advertising programs, seeks to serve a maximum number for an economical cost.

The root difference, therefore, between such technical factors as station location and power and wavelengths used in the two contrasted systems is that the public service plan spreads its service far and wide, attempting to serve rural as well as urban areas, while the advertising system crowds its different and competing stations on the urban boundaries. The British rural listener is thus assured the robust service of at least one program—the wants of the American rural listener are not consciously studied.

Even assuming that there were no serious limitation to the number of stations which could work at the same time within the same zone of darkness, it would be obvious that those who were only concerned with commercial profits—direct or indirect—obtainable from broadcasting would rightly hesitate before spending millions of dollars on a station capable of giving a service to the sparse populations of a mid-western state when for a tenth the sum they could be sure of an urban audience many times greater. Advertisers seldom erect hoardings in the wilds of the jungle; no commercial broadcaster can obtain an adequate return for the operation of a purely rural service station.

On the other hand, because of the limitation of the number of simultaneously working stations, the taxed listener of a public service broadcasting system finds his range of choice between different types of programs either limited or non-existant. The American listener is, in this respect, far better off than the British.

Early Conditions of British Broadcasting

The writer, in his capacity as Chief Engineer to the British authority, realized this disadvantage of the monopoly system of broadcasting and sought to alleviate it if not to overcome it altogether. It was the basic object of his regional scheme of broadcasting to assure the majority of British listeners, rural, suburban or urban, the possibility of a choice between at least two entirely separate transmissions, to assure every listener rural or urban a good service from one station.

The scheme was conceived about eleven years ago. Permission for its inception was given about seven years ago. Although the writer has long since left the Corporation, the scheme is not yet completed.

At the time of its inception few of the European authorities had begun to take broadcasting seriously. Germany, however, was building stations very rapidly, the French authorities were debating whether broadcasting was legal, while French private enterprise was erecting and operating stations without caring very much whether they were or were not permitted to do so; Holland, which possessed stations before England, and the Scandinavian countries were beginning operations. Conditions were, therefore, not very favorable to an agreement regarding international wavelength allocation. The writer took, however, a leading part in attempting to obtain an agreement between the various nations because it was clear that without such an agreement national planning would be abortive for want of international co-operation.

The basis of a European agreement was achieved at a conference held in Prague in the year 1927. Great Britain found herself with nine *exclusive* waves, that is she could erect and use nine different transmitters without a great fear that other stations would be set up by other nations which would interfere with these nine British transmissions.

The Objects of the Regional Scheme of Broadcasting

Thus, about 1927, the given factors in national broadcasting were:—

1. That any scheme of station distribution for Britain would have to attempt to assure to every listener, urban, suburban or rural, a day and night, uninterrupted, robust service of at least one program.

2. That Britain could be assured of the use of nine exclusive channels for broadcasting and that these limited facilities would have to suffice as the backbone of any scheme of broadcasting.

3. That the great disadvantage, viewed at any rate from a human rather than a bureaucratic viewpoint, of public service broadcasting was the lack of opportunity it afforded to the ordinary listener to have a choice of clearly heard alternative programs.

It was and is, of course, perfectly true that the owner of an ordinary set could and can "pick up" programs coming from distant and what we call in Europe foreign stations. It is always difficult, however, to be certain that these programs can be heard without suffering severe interruption from static —man-made or atmospheric. It has always been the writer's contention that even the best and most entertaining programs are robbed of their full value if they are accompanied by extraneous noise or if they periodically fade away to silence. It was his conception that if radio were to have real entertainment value or were to do justice to musical performances, its reproduction should be clear and contain a frequency gamut embracing, at any rate, the majority of the audio-spectrum.

It was the object of the Regional Scheme of broadcasting to set up a number of centers of transmission scattered through out the island so that, as far as possible, every listener could be assured of the reception of *two* robust continuously available and uninterrupted programs.

Technical Bases of the Regional Scheme

The scheme as originally conceived was to choose five widely separated geographical locations and to erect there twin-wave stations giving a dual program service to the surrounding areas. A twin-wave station is a station in which one building houses two distinct and separate transmitters radiating waves of quite different length and therefore creating transmissions easily separable in the tuning filters of the ordinary receiving set. It is easier to separate two transmissions in a given receiving set when each is widely separated in frequency and is of comparable strength. One of the difficulties in the systems of broadcasting which grew up haphazardly was that listeners might live in the shadow of a powerful broadcasting station and, "wiped out" by the relatively very strong signals, would not be able to pick up other transmissions. The Regional Scheme was planned to insure that, however close a listener might live to a given station, he would never be restricted to only one signal since two strong signals carrying two contrasting programs would be always available.

The reader is asked, in order to make this clear, to look at the diagrammatic sketch in Figure I. The outline represents the British Isles. The dots are the transmission centers.

Fig. I. A purely diagrammatic representation of the British Regional Scheme of broadcasting. The dots represent the station locations. Each station has two transmitters. The circles show the limit of range of the transmissions so that anyone inside the circles has a choice between two programs. In actual practice the areas of service are more restricted (see Fig. II) and the long wave station at M serves practically all not served from the regional center.

The dot L is the London transmission center from which point the service spreads over the metropolis and the home counties. W serves the densely populated South Wales littoral facing the Bristol Channel; the coast towns are bombarded by signals passing across the water, over which radiation suffers little attenuation; the Devon-Cornwall peninsular is also served from this station

The densely populated Midlands are served from the location M, the industrial North from N. The station N—the Northern Regional Station—stands on the heights of what is called in England a mountain chain—with peaks even 2,500 feet high—to straddle the counties of Yorkshire and Lancashire which are divided by this chain. The Lowlands of Scotland are served from S, a station midway between the capital of Scotland, Edinburgh, and the industrial city of Glasgow.

It will be seen that the circles—which are diagrammatic and exist for the purpose of explanation rather than exact definition—are, with one exception, 60 to 80 miles in radius. Generally speaking, good service may be expected within the areas embraced by the circles; outside this area service cannot be guaranteed. The area embraced is called the service area of the station to which it appertains. Naturally, the stations can be heard over a vastly greater territory than that inscribed in the diagram, but outside the boundaries of true service area signals are bound to be variable and frequently interrupted by extraneous interference. The public service engineer is bound to define these areas, conservatively, as those in which day and night, winter and summer, a robust, unwavering and clear signal is obtainable.

The range of a station is, in these terms, greatly limited, but the actual appreciable penetration of the waves may extend at night to even thousands of miles.

The true service range of a station depends upon four factors. (1) the wavelength used, (2) the power, (3) the nature of the earth's surface over which the waves must pass, and (4) the expected average intensity of atmospheric interference. The longer the wavelength the greater the service range, but the worse the atmospheric interference. The more arid and mountainous the ground over which the waves must pass the more restricted their range. Waves pass easily over open water and lush and pastoral country. Atmospherics are worse in southern than in northern latitudes.

Thus, for northern latitudes, the station which has the greatest range for a given power uses a wave of the greatest possible length. But the number of "long" wavelengths available is limited—all the European countries clamor for the possession of a long wave channel because they are so useful in extending service to the scattered rural populations (and also, very often, in conveying national propaganda across international boundaries!)

The B.B.C., which pioneered long wave high-power broadcasting technique, possesses only one long wave channel (length 1500 meters). The station radiating the long wave is located at M in Figure I. It will be seen that its service area extends over a far greater territory than that served by the other stations which perforce use waves of medium length—between 500 and 200 meters. Thus, most of the rural areas not served by the medium wave stations are assured of service from the long wave station, located, naturally, in the geographical center of England. Fig. I shows how the scheme was conceived, not how it had finally to be adapted to existing needs.

Quantitative Survey

The Regional Scheme, while based upon the principles outlined, has to be modified because the quantities revealed by a factual study, the claims of minority populations and and the lack of sufficient channels, make it impossible to follow the simple ideology of using only the five transmission centers as outlined above.

Fig. II (a). Distribution of the Regional Program as predicted. Refer to Fig. I and notice that Fig. II is the actual distribution from centers L, W, M, N, and S which was shown purely diagrammatically in Fig. I. A is the boundary of the A service area, B of the B area, and so on. A has a strength of 10, B 5, and C 2.5 mv per meter. C is taken as the limit of service.

The chief, indeed the only, limiting factor is the number of channels available for national broadcasting. Thus, there are only nine exclusive channels, but with five centers of twin wave radiation, obviously ten channels are demanded. This difficulty is solved by sharing one wave between two stations. This greatly limits the service area of both; quality, even when the same program is radiated from each station, is poor at receiving locations where the strength of the two stations is comparable. Or, put in another way, it is necessary for a receiving location to be in such a position that the strength of field, created by one of the stations sharing a wave with another, shall be at least five times that of the other if good quality reproduction is to be obtainable at that location.

Listeners close to one of the stations sharing waves get, therefore, good service. Listeners who live in areas where the strength of each of the stations is comparable have to get their service from another station altogether. Thus, suppose the stations L and W (Figure I) share a wave, a rural listener who is not close enough to either to get good quality, will tune in the long wave transmissions coming from M. He will not, under the scheme, be at a disadvantage because M radiates the same program as is also simultaneously radiated by one of the transmitters at W and one of the transmitters at L.

It has been said that the scheme exists to give every listener a choice between two programs. A theory of program building says that, given a certain income, it is better to spend it so as to buy a limited amount of first class talent than a large amount of differing but mediocre talent. The B.B.C. thus arranges and pays for what is called a national program, and this is radiated by one of the transmitters at *each* regional center. The national program, as its name implies, is nationally distributed. It is usually created in the London studios. Each of the other transmitters at each regional center exists to give the possibility of the radiation of a regional program contrasting with the national program. The idea in the writer's mind when he framed the Regional Scheme was that each region should have an autonomous identity and should create programs of a distinctly regional character reflecting local aims and culture and different interpretations of the art of broadcasting. Thus, referring again to Figure I, each center, L, W, M, N and S, radiates, from one of their transmitters, the same national program, and, from the other, a regional program which is intended to be a different program at each region. No listener, therefore, gets a choice between more than two programs, one of which is, universal and for every listener, and the other a program emanating from the nearest regional transmission center.

It is necessary to understand that the circles shown in Figure I are purely diagrammatic. The waves are variably attenuated according to the nature of the terrain they must traverse. Mountains interpose barriers, seas and lakes conduct the waves strongly and so the service areas take on shapes which are far from circular.

Figures II_a and II_b show the real predicted service areas, one for the national, the other for the regional programs. These actual boundaries are very nearly representative of what has now been realized after the stations were created. A quantitative analysis based upon the distribution of population and the distribution of stations shows that about 80% of the population get good service of two and 98% of one program.

The medium wave transmitters have a power of 50 kw. and the high power long wave station has lately been rebuilt to have a power of 150 kw.

This necessarily brief survey can do no more than reveal the outlines of the Scheme as the writer conceived it originally. There are, in fact, to-day many divergencies from the scheme as outlined, but the main conception of the functions remains and the twin wave stations are at this moment all functioning.

The clear cut ideas underlying the British scheme have been, technically speaking, realized, but an article principally addressed to readers living in America, where such an entirely different scheme of broadcasting prevails, should not be allowed to convey the idea that its author is satisfied that the British system represents finality, either constitutionally or technically. Indeed, whenever the writer spends an all too brief time in America, the more he is convinced that the American system is, in the final analysis, superior to the British. These British alternative programs are only alternative in the content of the items, not in the spirit which creates them. Each program reflects the attitude of bureaucratic control and produces in the minds of listeners either an attitude of complacency or acts as subtle propaganda for stagnancy or the status quo.

It is all very well to plan a successful technical system—judgment of its sociological value must rest with how that planned system is used. There is more sociological value—so the writer believes—behind the free, forthright and outspoken American (advertising) programs than those which reflect only the carefully edited, precise and meaningless efforts of bureaucrats who, in the last issue, must please and satisfy the government.

Fig. II (b). Distribution of the National Program. Only B service areas shown when M predominates. M, the chiefly important station, uses a long wave.

CHROMIUM—PAST AND PRESENT

By C. E. WESTON
Electro Metallurgical Co.

THE first chapter in the story of chromium was written in the uneasy days of the French Revolution. Indeed, the revolution almost delayed the discovery of this element when it vented some of its spite against Vauquelin, peer of French analytical chemists.

From a mine in the Ural mountains near the city of Sverdovsk—where Czar Nicholas II was supposedly executed in 1918—came samples of a heavy red rock for analysis. Vauquelin reported the analysis in terms of elements that had been described prior to that time, none of which, of course, was chromium. Other analysists working on the same mineral obtained vastly different results. To settle the resultant argument Vauquelin repeated the analysis and, with a different treatment of the mineral, obtained a new substance which displayed solution or precipitate colors of red, yellow, or green depending on the treatment. He recognized it as a new element and named it chromium from the Greek word meaning color.

There is some doubt whether Vauquelin ever isolated metallic chromium. He did however study its compounds quite thoroughly and described many of them fully. The metal itself was difficult to prepare owing to complexities of reduction, so it was some time before chromium was anything but the base of a series of beautiful and also useful compounds.

Metallic chromium from the time of its initial description until about 1850 was somewhat of a laboratory curiosity and as such received attention from several of the purely scientific chemists and physicists. The first record of the use of chromium for alloying iron is Stodart and Faraday's report published in 1820. Berthier in 1821 described chromium steels and reported among other properties that the alloys tend to be harder, more brittle, less magnetic, and less easily attacked by acid with increasing chromium. These studies, however, were largely academic and nothing of commercial value resulted from these iron-chromium alloys of a century ago.

In the meantime the salts and compounds containing chromium were becoming widely known. Potassium dichromate was immediately recognized as a powerful oxidizing agent and the colorful compounds were widely used in the ceramic industry to impart various shades to enamels and glazes.

This was practically the complete story of chromium until the start of the present era of utilization which had its slow inception about 1860. What has been done with chromium from then until now is more a story of modern progress, and the use of chromium has been not as part of a compound, but as itself—a metal.

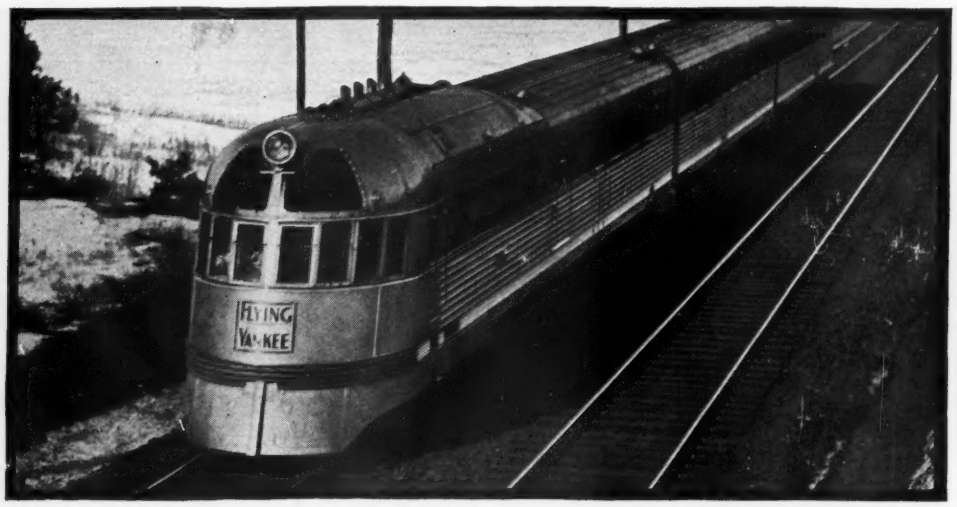
Chromium metal is steel white, harder than iron and capable of taking a brilliant polish. It has a specific gravity of 6.9 which makes it a bit lighter than iron. Its melting point is high and in the molten state it oxidizes rapidly.

Chromium is derived principally from the ore chromite, which is quite widely distributed over the world. When the demand for chromium and chromium compounds became great enough to be known on the world market, mines were opened in various localities, some in the United States and others in Asia and Africa. The most productive of these in former years were those near Brusa in Asia Minor, which reached peak production in 1908. Developments in Southern Rhodesia, New Caledonia and India assumed importance and caused a decrease in the production of the Asia Minor mines. At one time extensive mining was carried on in Maryland and Pennsylvania also. The largest tonnage at present is coming from Rhodesia in South Africa.

While most of the chromium comes from the mineral chromite, it is found also in a great many other forms. The Siberian ore with which Vauquelin experimented, was the lead chromate, corcoisite. Chromium is also found as chrome ochre, Cr_2O_3, and in various other combinations. The green color of the emerald, chrome-garnet and serpentine, and the red color of the ruby and some sapphires are due to small percentages of chromium.

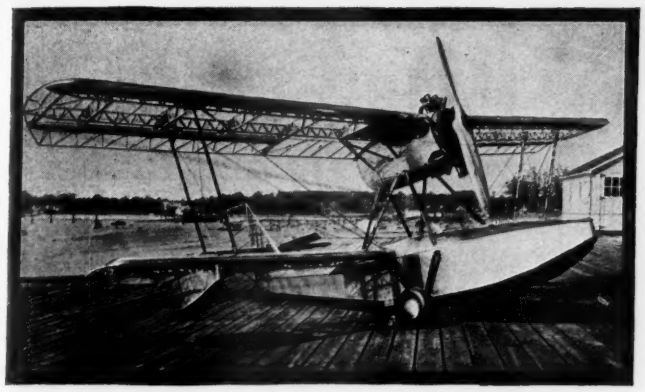
The major portion of the metal used at present is produced in electric furnaces by treatment of chromite. Reduction of chromite produces a mixture or compound of iron and chromium which is known as ferrochromium. This ferro-alloy affords an ideal way of adding chromium to iron and steel in the preparation of alloy steel. A certain amount of chromium metal relatively free from iron is also produced for use in the preparation of special alloys which do not have an iron base.

The common grade of ferrochromium is produced today by electric furnace processes developed from the pioneer electric furnace experiments of De Chalmot in 1896 at Spray,



The stainless steel Flying Yankee is completely streamlined to offer minimum air resistance at high speeds.

—Electromet Review



—*Electromet Review*

Seaplanes like ships are corroded by salt sprays. The use of 18-8 chromium-nickel steel for the structural parts of this plane overcomes this problem.

North Carolina. The more highly refined low-carbon grades of the alloy are produced very largely by processes developed by Dr. F. M. Becket about 1907. The earliest work on these methods were part of the astoundingly productive research at Niagara Falls based on the availability of quantities of cheap power from the first large hydro-electric power plant in this country. Circumstances there brought together a unique group of experimenters from whose work has sprung most of our present electro-chemical and electro-metallurgical industry. The ferrochromium processes have been further improved and cheapened by the same man until the present very low carbon alloy was achieved which has made the more startling modern stainless steel development possible. The large scale production of ferrochromium coincided with the development of the electric furnace. An interesting fact in this connection is the development of the electric furnace method of producing artificial rubies. They are manufactured in France and Switzerland in large quantities from substances containing chromium and aluminum and in composition are practically duplicates of the natural stones.

The present day uses of chromium are as chromium compounds, chromium-plating and chromium alloys. Chromium compounds are used extensively in chemical work and also in the coloring of ceramics. An appreciable amount of chromium is also used in the chemical tanning of light leathers. This process of tanning which was invented in America in 1884 produces what are called in the trade "chrome leathers." Soluble chromates and bichromates are employed widely in the dye industry as mordants for producing and fixing "fast" colors. They are also used in dyeing khaki.

A large and rapidly increasing amount of chromium is being used in the form of chromium-plating. This is the only form in which chromium reaches the ultimate consumer as the isolated metal. For all other uses chromium is alloyed with some other metal. In chromium-plating the article to be plated is suspended in a solution of chromic acid. When a powerful electric current is passed through this solution, metallic chromium is deposited upon the article being plated. Chromium-plate readily takes and retains a high polish which is quite immune to tarnishing. It is also very hard and has high resistance to wear.

Chromium-plate is used for two classes of service. First, for decorative purposes such as automobile trim, household utensils and plumbing fixtures. Second, for resistance to wear and abrasion, as illustrated in the chromium-plating of machine parts such as diesel engine piston rods.

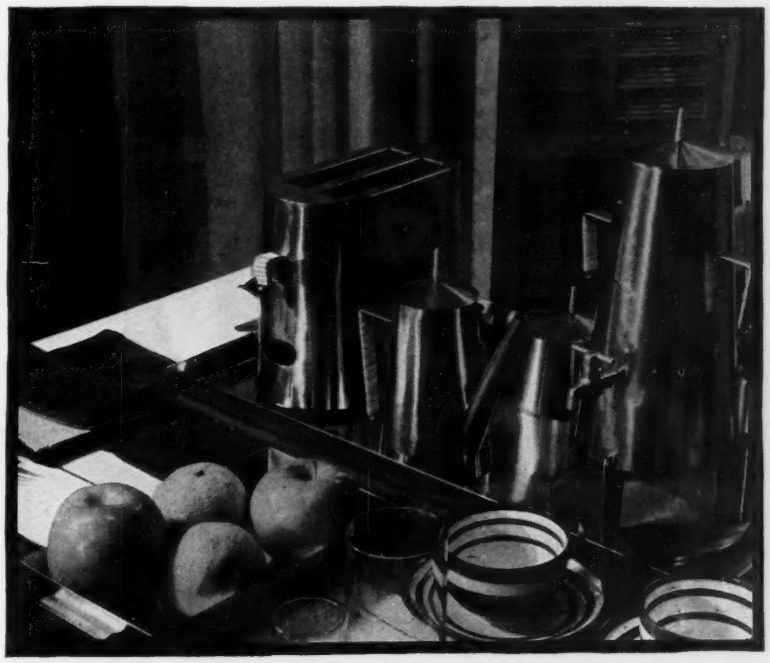
The greatest portion of the chromium produced today is used in the manufacture of alloys and alloy steels. Chromium has the unique ability of imparting its own properties to metals with which it is alloyed and it also serves to enhance the value of other alloying metals in effecting improvement in physical properties.

Chromium with other elements such as nickel and aluminum forms a series of alloys unexcelled as resistance elements in electric heating appliances. The heating elements in electric irons, toasters, and curling irons as well as other similar devices are made of these alloys. In industry these same alloys are used in many types of electric heating furnaces.

Chromium metal is also used in the preparation of Haynes Stellite, an alloy of chromium, cobalt and tungsten, which is characterized by its extremely high resistance to wear and by its ability to retain its exceptional hardness even when heated red hot. These unique properties make Haynes Stellite particularly valuable for use as metal cutting tools and for applications as a wear-resistant surface coating to metal parts that are subject to severe abrasive wear. Recently the use of Haynes Stellite as a valve seat material in automotive engines for trucks and buses has been found to eliminate to a large extent the need for valve grinding.

It is as an alloy of steel that chromium contributes most to modern progress and the chromium steels now consume the largest percentage of the world's production of this metal. Chromium exerts such a powerful influence on the physical and chemical properties of steel that a large portion of the special steels upon which industry relies for exceptional service contain this element. The first production of chromium steels on a commercial scale, about 1869, represents the beginning of the present chapter in the utilization of chromium. In

(*Continued on page 108*)



This breakfast set has aroused interest toward the artistic possibilities of stainless steel. It was displayed at the Industrial Arts Exhibit of the Metropolitan Museum of Art, New York. In a period of 63 days nearly 140,000 people saw the exhibit.

—*Electromet Review*

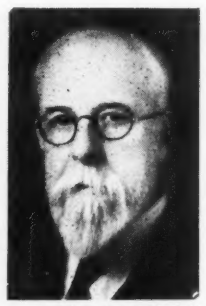
Investigating

BUILDING COLLAPSES

to Safeguard Life and Property

By ***RUDOLPH P. MILLER***
Former Sup't. of Bldgs., Borough of Manhattan, N. Y. C.

THE statement, made by Theodor Scharff, head of the Baupolizei of Hamburg, after a tour of the United States, which included visits to the building officials of its leading cities: that building failures in this country were apparently less numerous than in Germany, was particularly interesting to one who had an experience of seventeen years in the building industry, for the most part in connection with the administration of building laws. The statement was not only interesting but startling, for it had been quite generally understood that governmental regulation abroad was more rigid and effective than on this side of the Atlantic. Yet, only a few months later, another German visitor, building official of Berlin, who also had studied building conditions from coast to coast in this country, in an article published in the Deutsche Bauzeitung supported the finding of his colleague.



—*A.S.T.M. Bulletin*

The latter observer attributed the better record of this country to the use of larger safety factors made possible by the lower cost of building materials; the universality of standard construction practices; greater labor efficiency as the result of higher wages; the more general employment of well-trained technical men as superintendents of construction; the closer supervision, more particularly in larger operations, by the designer of the project; more frequent governmental inspection; and greater severity of penalties for departures from official approvals or violation of statutory requirements.

After another twenty-three years' contact with building construction, partly in an official capacity, but chiefly as a private practitioner, it is still hard to give full credence to the assertions of these two officials whose competency, based on personal acquaintance, is not questioned. Although building collapses might have been more frequent there than here, the number and seriousness of those met either in public office or in private practice, have been sufficiently severe to be impressive.

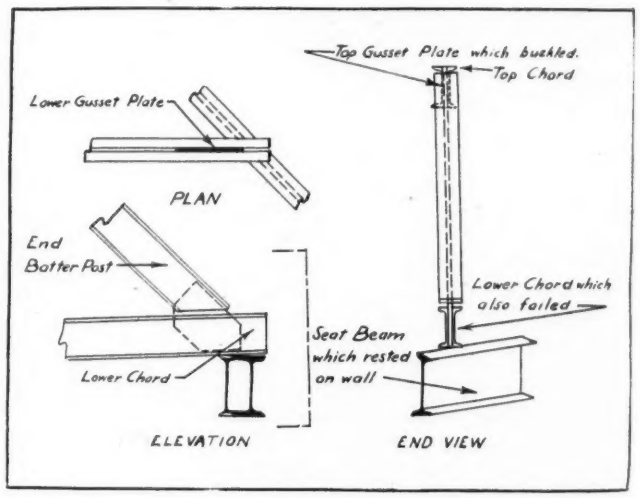
Probably the most serious of these catastrophies was the falling of the roof of the Knickerbocker Theater, in Washington, D. C., in 1922, resulting in the deaths of nearly one hundred persons and injuries to about two hundred others. Because of an unusually heavy snowfall on that evening the attendance, between 400 and 500 persons, was only about half of the seating capacity. Shortly after the commencement of the performance and without previous warning the entire roof, an area of about 14,000 square feet, dropped into the auditorium. The roof construction, of steel trusses and purlins supporting a reinforced concrete roof slab, relied for its chief support on the main truss which extended from the street wall for a distance of fifty-five feet to a column near the rear wall. It was this main truss that failed, slipped off of its bearing and brought down with it the entire roof. The building, at the time of the collapse, had been completed and in use for more than four years. It is conceivable that the weight of the snow, estimated at twelve to thirteen pounds per square foot on the roof surface, furnished "the straw that broke the camel's back," in an already over-fatigued structure.

Two thorough investigations by a committee of the Washington chapter of the American Association of Engineers and a board appointed by the Associated General Contractors, revealed so many defects in design and construction which contributed to the failure of the main truss, that enumeration here is impracticable. The more immediate causes of the failure were: the buckling of the gusset plate that connected the top chord and the end batter post, being the sole means of transmitting the top chord stresses to the end post, and the crippling of one of the channels of the lower chord where it extended beyond the batter post and constituted the support of the truss on the wall. Which of these actions occurred first it is impossible to say; either was sufficient to induce the other or bring about the collapse. Some of the other contributing causes were a skew bearing of the truss on the wall; underestimated dead loads; excessive working stresses; inordinate secondary stresses because stress-lines did not meet properly at connections; and center of stress at end bearing falling on edge of wall.

In discussing the responsibility for the Knickerbocker Theater collapse, the A. G. C. board remarked that

> "In the erection of a building, particularly a building to be used as a public gathering place, *all* persons engaged in designing and erecting the structure are jointly and severally responsible for its safety."

The statement embodies a principle of law that it would be well for those engaged in the building industry to keep in mind. It was forcibly impressed on one subcontractor who, as the only financially responsible party engaged on the structure of a twelve-story hotel in New York City was compelled to meet the money damages awarded in a suit arising out of the injury of a workman in consequence of its collapse.



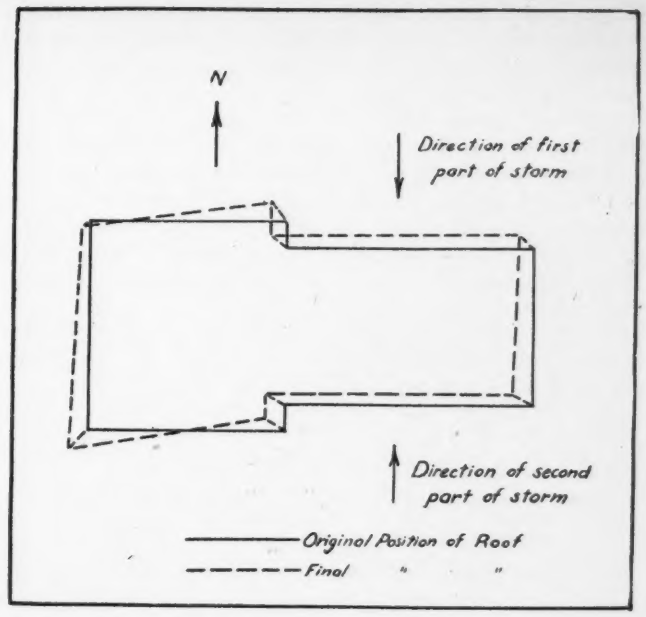
End of main truss of the Knickerbocker Theatre in Washington which slipped off the seat beam.

This subcontractor was installing a fireproof floor filling, which construction was required by law, as the erection progressed. The skeleton frame had reached the eighth story, when, because of its badly honey-combed condition, this defect being aggravated by certain bad features in the design of the structural work, one of the cast iron columns in a lower story broke and caused the structure to fall to the ground. When the accident occurred the owner, a speculative builder with meager tangible assets, fled to foreign parts. The subcontractor it was held, was under obligation before proceeding with his contract to assure himself that all construction that preceded his work was safe and lawful.

The hurricane of September 18, 1926, "the most violent in memory and in some 50 years of record," was productive of great havoc in Miami, Florida, which city lay practically in the center line of its path. Wind velocities were estimated at 120 m. p. h. and higher. Much of the destruction, especially in the case of the less pretentious structures, was due to the use of poor materials and to the bad workmanship that prevailed during the real estate boom of the years preceding the storm. Practically none of the buildings which had been properly designed and in the erection of which good practice had been observed suffered structural damage. The building which figured prominently in the reports of destruction was a 17-story business building known as the Meyer-Kiser Building. It was a comparatively narrow building: having at the front and for a depth of 32 feet a ratio of height to width of about four; and for the other 108 feet of depth, a ratio of five or more. It towered above the neighboring buildings, standing isolated above the second story. It thus had the full force of the wind, battering its long sides, in one direction during the first half of the storm and in the other direction after the eye of the hurricane had passed. The building did not collapse; though the front wall masonry was demolished from the fifth to the eleventh floors, and in one of the side walls several wall panels were shaken out. The most serious damage was the distortion of the steel frame by the bending of the front wall columns to such an extent that the building at the roof was overhanging sideways to the extent of two feet. The steel frame showed no provision for adequate wind resistance; the connections of girders to columns were lax, it being necessary in many cases to insert several filler plates in order to secure contact. Workmanship generally was poor. One point worth particular notice was that the narrower section of the building resisted distortion much more effectively than the wider part. This was because of the type of floor filling, a proprietary hollow tile system, which was used; in the narrower section the blocks were 10 inches deep and set between the steel beams, whereas in the wider section they were 6 and 8 inches deep and rested, in the main, on the upper flanges of the beams. In the latter section parts of the floor panels had fallen out and the balance showed unmistakable signs of horizontal torsion.

The torsional movement observed in the Meyer-Kiser Building at Miami, as an effect of high winds, was also found in the 15-story steel skeleton of the Realty Board building where measurements showed a shifting at the roof of $1\frac{25}{32}''$ to $3\frac{7}{8}''$, in a westerly direction at the northwest and southwest corners, and in a northwesterly direction at the southeast and northeast corners. The desirability of horizontal rigidity, furnished either by a stiff floor filling or by bracing in the steel floor framing, is evident.

The destructive power of wind was further shown in its effect on a reinforced concrete hotel building under construction in an outlying section of Miami. The construction had progressed to the extent of completion of the structural frame, floors and roof, and the exterior hollow tile walls except in the eighth and ninth stories where the tile walls had been carried up to window sill level only. The sixth to ninth stories constituted a tower rising above the main roof and



Plan of the roof of the Realty Board Building in Miami.

were 52 feet deep, 44 feet wide in the lower three stories and 25 feet wide in the top story. The roof of the tower, of pyramidal shape, was supported by four columns evenly spaced along each of the two long sides. The top story being unenclosed the wind had full sway and exerted its full force in the domical space *under* the roof. Coming in terrific gusts, as the wind does in violent storms, it evidently caused the isolated roof columns, lacking bracing and lateral wall support, to sway thus loosening the reinforcing rods that extended into the lower columns and finally lifting the roof and its supporting columns along one long side, and precipitating them by rotation about the bases of the columns along the opposite side in such a way that the roof fell upside down on the roof of the wider eighth story. Sufficient information was gained to lead to the belief that the best practice had not been followed.

In September, 1923, shortly after the workmen had quit work for the day, the night watchman on a two-story and basement school building under construction at Binghamton, New York, heard a cracking sound which, when he started to investigate, continued, causing him to leave the building just in time to escape being buried in the section which collapsed. The section, covering an area of about 3500 square feet, constituted ten percent of the entire building. The structural work had just been completed; the concrete of the roof, having not yet had time to set. The lower portions, exterior and interior bearing walls and floors, had been in place long enough to attain their required strength. A corridor wall in the basement was the support for the bulk of the construction at this point. This wall was built of hollow tile, eight inches thick. Door and window openings concentrated at the central section of the wall, aggregated fully one third of an unsupported length of more than 100 feet. In addition vertical chases for electrical conduits had been cut, recklessly, at several points in this wall. Examination, as the debris was being removed, indicated that a pier between two of the openings failed. Calculation showed that the dead load alone was more than twice the rated safe capacity of well-built masonry of the type used and in excess of the ultimate strength developed by test of samples of similar masonry selected from unaffected parts of the building.

Commenting on the frequency of failures of buildings under repair, *Engineering News-Record* remarked editorially

"there is more hazard in the remodeling of the ordinary structure than there is in its construction." A case in point is the disaster that occurred in New York City, when several workmen were killed and injured while making repairs in a three-story beer storage house. Incipient decay of the wooden joists of the first floor prompted the owners to replace the existing construction with a new floor of fireproof construction. To relieve the floors of their loads during the alterations the vats and tanks in the several stories had been drained, and in addition some were removed temporarily. The position, after the collapse, of the fallen floor beams and the loads they had supported indicated failure at one point in the cellar where the work was in progress. Inadequate use of temporary wooden supports before removing some of the structural elements proved, upon examination, to have been the cause of the mishap.

Building casualties are not always the result of conditions within the structure itself but may be brought on by external circumstances, as in the case of two occurrences within six months of one another, one in Boston and one in New York City. In both instances the side wall fell into the adjoining lot. Both buildings were occupied by night clubs and the failure took place while the resorts were well attended. In the Boston case more than 40 persons were killed and many injured; in New York there were no deaths but about a dozen injuries. Excavation for new buildings was a contributing, if not the direct cause of collapse. In the Boston case, the wall had been underpinned with substantial concrete piers; but neglect to counteract the lateral pressure, caused the rain-soaked soil to topple them over into the excavation, bringing down the walls they were supporting. In New York, reliance had apparently been placed in the fact that the excavation was not to be carried below the footing and no effort had been made to brace the wall. It is possible that in this case the masonry, because of its age, was in a deteriorated state. It is not unlikely that vibration resulting from dancing had some influence on the disastrous movement.

One of the important provisions of a comprehensive building code is that which requires the conspicuous posting of the load per square foot that each floor will carry safely and making it unlawful to place on any floor loads in excess of its rated capacity. This prescript is not always observed and now and then warehouse floors are unable to bear the burdens imposed by the mercenary proprietor. In failures due to overloaded floors generally an overstressed floor beam snaps thereby suddenly imposing additional load on its neighbors causing them to break, precipitating their load on the floors below till the debris goes as far as it can. In the meantime the floor beams in disengaging themselves from their supports fall against the walls and bring them down together with such loads as these may still be carrying. This hazard is especially great in old residence buildings which have been converted into warehouses, perhaps illegally without knowledge of the building authorities, a situation that was not unusual some years ago in large cities.

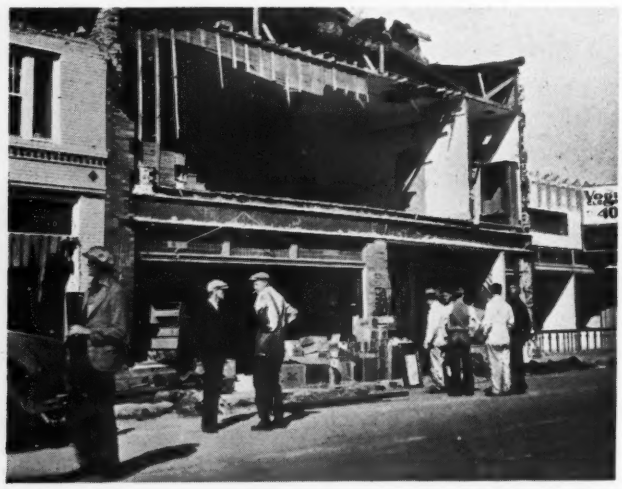
A prolific source of trouble is the so-called temporary structure which includes reviewing stands set up for public pageants or parades; speakers' stands for out-door celebrations and political gatherings; bleachers erected for athletic meets, football games, circuses, boxing bouts; and other similar structures. Some of them are designed for large crowds. Too frequently, insufficient attention is paid in their design to safety and stability. The desire to build them as inexpensively as possible leads to their construction, frequently with no plan, by irresponsible mechanics who have little knowledge of the principles controlling safe design.

From press reports, taken at random during the last thirty years, of accidents in structures of this kind in twelve widely scattered localities of the United States, it is estimated that about 15,000 persons were involved in the 30 cases analyzed. Thirty-three fatalities were reported and fully 1500 injuries of which 250 were serious. Personal observation of such structures and incidental remarks in the published accounts are convincing that the most frequent cause of failure is the lack of adequate bracing. Crowds occupying the stands are liable to intense excitement so that with stamping, moving about and other nervous actions, swaying and vibrations are set up that demand rigidity of construction to resist.

Closely allied to the temporary structures for the congregation of spectators is the sidewalk shed, a structure prescribed by some building laws to be erected where a building operation is in progress, for the protection of pedestrians against the accidental dropping of tools or materials. Builders frequently use it also, when of sufficient strength, for the storage of materials. As distinguished from the grandstand where dynamic loads must be provided for, this structure is subjected practically to static loads alone; possible distortion, however, must not be overlooked and sway bracing of some kind is necessary. A deficiency in this last respect was adjudged to be the cause of the collapse of one of these sheds in New York which resulted in the death of a pedestrian. The city, besides the contractor, was held liable, being "charged with the duty to keep and maintain its streets and highways in a reasonably safe condition for the use of the public."

Many more casualties might be added to those here briefly reviewed. Each individual case has its own interesting features; but in general they would probably merely confirm the conclusions that may be drawn from those described. Briefly, the lesson that these disasters teach is the continuous observance of those well-established policies with which the Berlin building official has credited the building industry of this country: competent design and supervision, thorough workmanship, systematic governmental inspection, strict accountability for safe results. This desideratum is well expressed in a resolution adopted, some years ago, by Building Officials Conference, in convention assembled:

> "that for the better protection of the public against unsafe and illegal building construction, suitable legislation should be enacted by which building operations shall be restricted to architects, engineers, builders, superintendends of construction, or others who have by proper evidence shown their ability or capacity for undertaking such building operations and on whom individual responsibility for the safe prosecution of the work and a compliance with the laws relating to buildings can be placed."



An example of an old masonry structure built with lime mortar and with its walls and partitions not sufficiently tied together.

New Uses For

COTTON

—*A Universal Fibre*

By CHARLES K. EVERETT
Cotton-Textile Institute

COTTON is probably the oldest fibre known to man. Since antiquity it has served him in clothing, food and transportation and modern man knows cotton in a thousand and one familiar, established uses in the home, the wardrobe and in industry. And yet, after countless hundreds of years, there is always something new under the sun for cotton. A new style in milady's wardrobe opens up an entirely new field—men are convinced of the cool comfort and economy of washable summer suits and a vogue that sweeps the country is born—a national flare for knitting and crocheting is revived to consume hundreds of thousands of pounds of cotton yarns — ensembling household fabric accessories in colorful but always practicable cottons is made fashionable.

Through its Cotton-Textile Institute, the cotton textile industry is constantly engaged in the expansion of existing uses and a search for new uses for cotton. Annually these efforts are climaxed in National Cotton Week—which was observed May 6 to 11 this year—which, serving a double purpose opens formally for the merchants of the country their summer cotton selling season and at the same time centers national attention on the major role cotton plays in our every-day life.

To mention only two phases of that role—more than 12,000,000 persons in this country are dependent for their livelihood on the growing, processing and distribution of cotton; and the other fact not generally realized is that the cotton textile industry is the greatest single employer of industrial labor in the United States.

In the interests of that vast army of people, Cotton-Textile Institute experts are constantly collaborating with fashion stylists here and abroad, with nationally and internationally famous interior decorators and with educators, home economics teachers, extension workers, women's organizations and industrial research engineers. They cooperate with manufacturers, stylists and retailers for improvements in weaving, dyeing and manufacturing technique and many cottons are now available that are color-fast, shrink-proof, wrinkle-resistant and water-proof. These qualities, naturally, greatly enlarge the scope of the former Cinderella fabric as a fashion favorite. Not only are women using cottons for all items of their wardrobe, from sturdy play and sportswear to the sheerest evening frock, but men, too, have become comfort-conscious and are finding cotton wash suits invaluable in their summer wardrobe. Cotton neckties for men all but monopolized the Summer neckwear business this year, displacing long-established other types.

Swatches of the new materials are sent in from all over the country. Fashion experts select what, in their opinion, are the most desirable for inclusion in the Institute's Swatch Book for the guidance of manufacturers and retailers for the coming season. Other bulletins and promotional material are issued at frequent intervals to aid the retailer in acquainting his patrons with the many advantages of using cotton.

It is a far cry from participating in the creation of Paris models of cotton underthings for women to co-operating with and architect in the building of a "cotton house" or with a state highway engineer in demonstrations of the practicability of "cotton roads", or cotton mats for curing newly-laid concrete pavements.

More unconventional, these latter fields are equally interesting and offer prospects of huge potentialities for consumption of cotton. For example, highway authorities in numerous states are now beginning to study in a serious way the possibilities of "cotton roads" in secondary highway systems.

In building "cotton roads", a cotton fabric membrane, laid on graded dirt or gravel and impregnated with asphalt or tar oil, covers the road base which is top-surfaced. The fabric, in effect, serves as a waterproof blanket which provides surface drainage for the road, adds to its strength and wearing qualities, insures greater smoothness and riding comfort and is measurably more economical in maintenance costs.

Experimental constructions, testing such roads under extremes of weather and other conditions, have been completed in several states. The first of the experiments was undertaken a few years ago in South Carolina. The latest was completed in August 1934, in New Jersey and withstood the rigors of a northern winter under heavy traffic as satisfactorily as the earlier constructions had proved themselves in the South.

Construction of a "cotton road" for the benefit of several hundred state highway engineers and road maintenance officials was a feature of the Memphis Cotton Carnival during the city's observance of National Cotton Week this year. Important developments looking toward the acceptance of the cotton road as good highway engineering practice are now pending.

Another interesting development is the use of cotton mats for the curing of concrete pavement, in place of straw and earth. These mats, 6 feet by 12 feet, are of cotton osnaburg fabric, stuffed with a layer of cotton filler and stitched or tufted to insure long wear. Their special hygroscopic qualities make them particularly adaptable for this use, in addition to their serviceability and economy, according to the results of several experiments conducted during the past year by both the Federal Bureau of Public Roads and the Texas State Highway Department.

Between December, 1933, and November, 1934, the Texas

(*Continued on page 107*)

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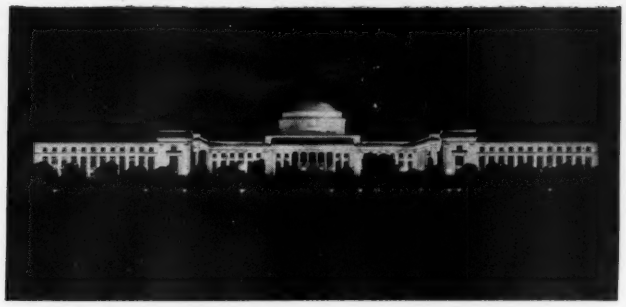


EDITORIALS

SURVIVAL VALUE

THE one fundamental urge which dominates the life of every living thing from California Redwood to Ethopian Potentate is the desire to survive. Charles Darwin made himself an immortal by his hypothesis of the survival of the fittest.

For a moment let your frolic fancy go back to the day last summer when you were footloose in some friendly barnyard and came to anchor beside the hencoop. Inside the wire were exactly fifty-three chickens—you counted them twice to make sure. But watch as closely as ever you could, there was no suggestion of group activity. Every single chicken acted solely and exclusively on his own account. Even when a young rooster's impatient zeal for a particularly squashy cricket was thwarted by the superior tactics of some other cockerel, the honest stir which their quarrel created was ignored by the group. Indeed, the disputants soon ignored each other.

And how easily the farmer's axe made that sacrificial descent upon each chicken's neck when the time came!

Now the crow is a bird of another color. He postpones the inevitable coming to an end of his own particular little world by posting a sentry to warn him of any approaching enemy while he feasts on the farmer's corn. One crow watches while the other crows eat, and thus all the crows survive longer than would otherwise be possible.

The bees and the ants have an even more elaborate system of group activity.

Man's discovery that there is survival value in group action is as important as his discovery of any law of physics. And exactly as each one of us must learn by the sweat of his own brow how to juggle F = Ma correctly, just so each of us has to learn by hard experience how to get along with other people so that the individual may survive longer because the group co-operates.

The sociologists estimate that the population of North America at the time of Columbus was in the order of 5,000,000 souls. It was incapable of supporting more, for when each man directly supplied everything for his own family and there was no co-operative specialization, it took square miles per person to sustain life. People per square mile were an impossibility. Today the population of the United States alone is over 125,000,000 people, and such is our division of effort that the combined skill of a dozen men go into the making of a single pair of shoes—to say nothing of the raising and assembling of the raw materials or the distribution of the finished product.

If you will listen to the body of competent opinion, you will discover that college has many values beside those offered in the classroom; none more desirable than some activity which will teach you enough about men so that you will

know what makes them tick and how to reap the survival value of co-operative group action.

Boys with mechanical ability who want to work all by themselves should become dentists. Others should read the handwriting on the wall as well as on the blackboard and act accordingly.

F. Alexander Magoun,
Professor of Human Engineering.

THE WARNING GLEAM

TODAY science occupies a position where it commands the respect and attention of the entire world. No longer are scientists regarded with fear and misgiving as crackbrains experimenting with black magic to the confusion of all humanity. Today the average man is buying technical books written especially for the layman and is just as interested in the winners of the Nobel science prizes as the winner of the literary award.

Science has conclusively demonstrated that it can be and is of service to the community. But the public acceptance of this fact is directly attributable to the favorable publicity that science has received in the press. All important discoveries and researches have been played up. Their possible benefits have been discussed both in news and editorial columns. An important scientific gathering, such as the annual convention of the American Association for the Advancement of Science, can win as much as two full pages each day in a metropolitan newspaper.

But it is this enthusiastic and friendly press that may undo all the good they have accomplished, by their exuberance. Let a man announce that he has detected the presence of radium in ordinary materials. The next day the world will learn from its morning paper that radium can be extracted from anything. Imagine the effect of such a statement on an intelligent reader.

Another factor that will, unless preventive measures are taken, contribute to the inevitable change in the public attitude is the seizure of the scientist, of research, and of laboratories as a convenient smokescreen, by advertising writers. No longer does an advertisement contain three or four "unsolicited testimonials", or the picture of a girl in a bathing suit. Now the picture is that of a white-coated young scientist (sometimes he is middle aged and sports a Vandyke) pouring a gleaming amber fluid from a beaker into a test tube and saying, "Science shows that—". Be it a hand lotion, motor oil, or strained carrots, science always endorses it.

But the deplorable feature of this form of advertising is not merely that it reduces the scientist in the minds of the reading public to an automaton whose sole function in life is to test every commercial product put on the market, but that reputable scientists have in return for good and valuable considerations endorsed these products. Whether or not the endorsements are merited does not affect the matter. These endorsements can do the cause of science little good and a great deal of harm.

Unless science is ready to go downgrade it must fight these influences. Misquotations and exaggerations in the press must be stopped. Unscrupulous scientists must be prevented from trading on their prestige. And pseudo-scientific advertisements of machines that discover the hidden blue in a woman's face or release the subatomic energy of gasoline must be discouraged. Preventitive measures now will save embarrassment later.

A CIVIL SERVICE ACADEMY

IN surveying the present scene of political chaos, distrust, and corruption with a moderate amount of care, the thought occurs to one that the blame for this condition cannot be laid entirely to graft and dishonest politicians. Rather it is more plausible to suspect that there is something wrong or lacking with our method of selecting and training the various public office-holders.

Under the present system, any person who agrees to serve the state, who has a reasonable amount of common sense, and who has passed certain age limits is qualified to hold practically any public office in the country. Whether that person has been a doctor, a lawyer, or a business man, or whether he has attended a liberal arts college, a professional school, an academy, or no school of higher learning at all, does not affect the possibilities of his holding office in any manner. As a result we find many people in office who have no claim to their particular positions whatever, and still many more who are only partially qualified to hold their positions. No wonder inefficiency, waste, and chaos follow. What, for instance, could a one-time business man possibly know about a police department? Yet such a man was recently made chief of police in one of the country's largest cities.

We have a Military Academy at West Point, the avowed purpose of which is to furnish potential army officers the necessary knowledge and training to carry their future jobs to successful completion. The Naval Academy at Annapolis is based on this same fundamental idea. Why, then, not have a Civil Service Academy or group of Academies?

Such schools would train students so that upon graduation they would be fully equipped to cope with the many intricate problems that arise in public life. However, the curriculum need not, and should not, be composed solely of subjects pertaining to political thought, but should include a variety of other courses to give the student a broader outlook and to enable him to earn a living in any other field of endeavor. Added to this apparent difference between such an academy and the present Army and Navy Academies, there would also be the lack of a guarantee of a position upon graduation. Such a guarantee would be an enfringement upon the rights of the people. Rather, let the successful completion of a course at the Civil Service Academy or Academies be regarded as an achievement, and a basis for a trial in politics. Such a system would reduce the present contempt for politics to a remarkable degree, and would form the foundation for sound government.

AN INVITATION

TO the undergraduates, especially those of the Class of 1939, THE TECH ENGINEERING NEWS extends an invitation to participate in the competition for positions on the Staff of the magazine. Whatever your interest may be, there is a place for you on the T. E. N.—editorial, art, publicity, advertising, circulation, treasury and accounting. It will be to your advantage to become associated with the T. E. N. at the earliest date. A Smoker will be held within the next few days—why not come around and get acquainted? Visitors and candidates for the staff will always be welcome at the office in the basement of Walker. Come down and help us retain the Yale cup for undergraduate scientific magazines which we have won two years in succession.

ENGINEERING DIGEST

ZEPPLIN MODELS WHIRLED

EXPERIMENTS to determine the points of greatest strain on the exterior of zepplins when encountered by high winds are being devised at the Daniel Guggenheim Airship Institute. The most interesting device in the opinion of experts attending the recent lighter-than-air forum was a giant 2-ton arm as long as a city block is wide, which whirled 12-foot model zepplins in a great circle making them travel at the rate of 200 miles per hour. The arm itself resembles nothing so much as the old-fashioned horse power feed mill. It is mounted 10 feet off the floor on a 4-ton concrete and steel base.

The 12-foot zepplins have 60 small holes drilled in them from extreme nose to tail. Separate rubber tubes are run through the hollow whirling arm back to 60 manometers which indicate the pressure at each given hole in the hull. The glass tubes of the manometers contain a red fluid which stands out well in the form of a chart. The entire set up is automaticly photographed at one minute intervals thus making permanent records of the pressure on each one sixtieth of the model's length.

It is obvious that the data compiled from this device will be helpful in making future zepplins more sturdy where they experience the greatest strain.—*Science News Letter*

The Arm Whirls Model Zepplins at 200 milesan hour.

TELEVISION ADVANCES ABROAD

UP until the last year, experimentation with television in France was not much to speak of. However, thanks perhaps to recent British advances, namely the appearance of the British television report and Baird's experimental station of the London Crystal Palace, started with the radiation of television images by means of ultra-short waves, French advances in 1935 have been great. During the Paris radio show of 1934 there was displayed the system of Monsieur Barthelemy of the "Ecole Superior des P.T.T." featuring 30 lines a picture, but the picture quality was not attractive. Now there are two experimental lines in use in France. To excite interest, celebrities have been invited by the Postmaster General to visit the stations, and at one time a much admired French actress was well displayed on a 60-line system devised by Monsieur Barthelemy. The image was produced via radio pickup as radiated by the 400-watt transmitter. At present a great 10-kilowatt short wave transmitter is under construction. The new transmitter should be able to broadcast an image of 240 lines.

In Italy, Dr. Zworykin of the RCA is establishing the first television system which is capable of radiating pictures of 180 lines. In Prague, Czechoslovakia an official of the largest broadcasting company there states that television will soon be a part of its normal broadcast. Japan boasts three television development laboratories. Under Prof. Takaynagi of the Institute of Technology of Tokio, Japan is using their own independently developed system featuring a special electric lamp which produces a light of high usefulness in direct spot pickup. It has per unit an illuminating power of 1000 watts. Canada's department of Marine has licensed the Peck Television Company to operate a microwave demonstrator in Montreal. In Australia, Dr. Mc Dowell states that his television tests warrant a commercial transmitter.

Perhaps the greatest advances abroad in television are found in Germany. In addition to many experimental stations which provide programs simply to give factories anp experimentors a chance for check up of new assembled sets, etc., there is one very entertaining program (so reports say) broadcast by the Berlin television station which is causing considerable interest. At prices ranging between 300 and 500 dollars, 800 television sets have been purchased, this number being the total available for sale. At present, sets of two types are being made as quickly as possible. One type receives the 180-line system by means of many rotating small mirrors, and the other, by the cathode ray tube which seems to have by far the largest future. German manufacturers hope to sell at least 40,000 of these sets in the coming year if interest keeps up.—*Electronics*

RUBBERIZING THE KITCHEN

RUBBER seems to have come into its own in the kitchen. Unless we actually count up it uses; however, we perhaps undervalue it. But whether because of its actual merit, or because of extensive advertising and low prices, rubber tools and novelties literally litter the modern kitchen. Many housewives don rubber gloves before washing dishes. The Seiberling Rubber Company sells a "non-slip" rubber glove as the latest style. All-rubber dish scrapers are very common. Rubber holders furnished with rubber guards may be fitted over the "proverbial" steel wool when the Tasher tackles the pots and pans. Scrapers of all sizes and shapes are obtainable, their flexibility making them adaptable to any shaped plate or bowl.

To prevent chipping of dishes, anode-rubber-coated dish drainers are available. Rubber stoppers and rubber sink racks eliminate the scratching the sink usually receives. An ingenious sink strainer has been devised of rubber called the Rubbermaid. It is specially designed with holes at one end. Rubber legs raise the back of this strainer so that liquids quickly drain out. On the bottom, where the drain holes are located, there is a ridge of rubber all around. Two fingers of the hand may be placed within this ridge covering the holes and permitting the strainer to be picked up and emptied into the incinerator without dripping water on the floor.

Finally there are well ribbed rubber mats for pots and pans and mats to protect the floor around the sink. The entrance of rubber goods into the kitchen seems to have saved many chips and scratches both for the table and the kitchen ware.—*Rubber Age*

BROADCAST SYNCHRONIZING

AS the demand for wave lengths far exceeds the supply, the Federal Commission in Washington has had quite a problem in granting requests for more broadcast-station facilities without destroying clear channels or adding to the interference on shared channels. Political and every other kind of pressure strive to place fraternal, commercial, and educational interests on the air. The saturation point is near, however, where the entrance of a new station can not help but cause increased interference.

As yet the means by which channels may be opened with out more interference lies in the synchronizing of transmitters. Synchronizing of transmitters means simply maintaining the carrier waves of two or more transmitters on the same frequency within the narrow limits of about one tenth of a cycle. Beat notes, cross talk, and so-called side band "hash" may be cut out to a great extent. Also if the synchronizing is very precise, the inaudible beats, "flutter effects," may be lessened.

At present, WBZ–WBZA, Westinghouse stations at Millis and Springfield, Mass., are operated synchronously. WJZ–WBAL, at Bound Brook, N. J. and Baltimore, Md., and also WBBM–KFAB Chicago, Ill. and Lincoln, Neb., have devised methods for synchronizing their stations effectively.

If there was to be a new allocation of cycles and there will need be, synchronizing systems would be much in evidence. The present band (550 to 1600 kc.) might be rearranged to provide high-fidelity (20 kc.) channels, chain programs on three or four adjoining channels (each chain program at an established dial position wherever heard), facilities for five or more nation wide chains, super-power clear channels for rural coverage, additional stations for educational, fraternal, and religious groups, additional regional and local stations for profitable local operation, and chain stations delivering chain programs exclusively.—*Electronics*

PIPING PRACTICE

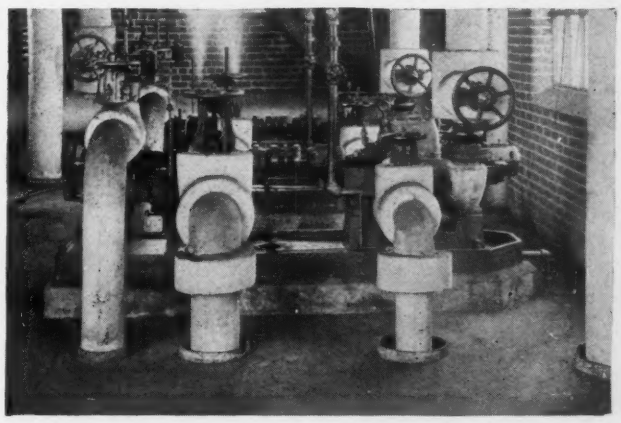
IN an industry involving the transportation of bleaching, dyeing, fluid finishing or other liquid chemicals the problem of suitable piping and piping maintenance is one of considerable importance. Mistakes in the choice of pipe as to its size, composition or joints lead often times to unwarranted costs. Regarding joints, pipe engineers consider the following points: (1) tightness of joint; (2) permance of tightness of joint; (3) labor cost of installation; (4) ease of disassembly for changes; (5) readiness with which materials or couplings may be obtained; and (6) first cost of installing or laying lines. Welded joints are usually used in extreme high pressure steam or gas lines. If, however, corrosion is likely to occur in the line, the welded joints are not easy to take apart, and therefore wherever possible flanged piping is used. In other cases, it is customary to use the threaded type of joint. Thread joints are most common when a variety of pipe diameters are used and there is constant need of replacement. Other joints as sleeve pipe couplings and gasket flanged types are used less extensively. In long mains and where diameters exceed 6 inches, the flanged type is preferred.

The problem of frictional resistance in the transportation of water and chemicals is generally taken care of by installing ample pipe lines to provide for future deposits in the interior of the pipe and by using smooth-bore pipes or cement-coated pipes where possible. Where additional machines are installed increasing the flowage, or when the extreme ends of lines become clogged with scale and deposit, this problem is important.

In replacing sections, joints, or removing corrosion, speed and efficiency are required of the engineer. Although in many cases where there is need of maintenance, sections of a line are removed, cleaned, and replaced; more often entirely new pipe is put in as the cost of removing scale and the time required to remove it is too much. Many times besides being merely clogged, a pipe is corroded more or less throughout, and the thread is useless.

A new type of coupling which is designed to permit the making of changes in water and chemical lines without having to subject the pipe to a finishing operation such as threading or grooving is attracting some attention.

There is no standard practice in regard to the reclamation of sections of water and chemical lines when revamping piping installations. As a rule, new pipe is installed, especially on chemical lines.—*Textile World*



Safe Piping

RESEARCH IN REVIEW

COURSE VI

FOR the past three years an investigation has been carried on in the Department of Electrical Engineering of the possibility of utilizing vacuum to insulate high-voltage power-generating and converting machinery. This work may ultimately lead to the development of vacuum-insulated electrostatic power machinery for the generation and conversion of direct-current power for transmission systems operating at voltages substantially higher than are now employed. Such systems, it is believed, because of the high-voltage and direct-current character and because of the simplicity and efficiency inherent in electrostatic devices, would remove to a large extent the present technical and economic limitations to the transmission of large blocks of power over long distances.

The successful development of this new type of power system depends primarily on the adequate realization of the high-voltage insulating properties of vacuum. It would be necessary, for example, to develop vacuum insulation to the point where voltages as high as 500,000 with a gradient of about 2,000,000 volts per centimeter can be safely insulated. Much effort has been directed during the last few years toward increasing the understanding of the factors upon which the insulating properties of vacuum depend. In the early summer of 1934 preliminary experiments on vacuum insulation had been extended to 500,000 volts, and the dependence of vacuum insulation on the presence of contaminating organic vapors and on the condition of electrode surfaces had been clearly shown. With an installation which has recently been completed and especially designed for research on vacuum insulation, direct-current voltages up to 700,000 have been insulated.

The generators and motors of the proposed power systme will utilize electrostatic forces developed in high vacuum. The machines are essentially variable condensers with suitable circuit connections and are formed of interleaving metallic discs, the rotors whirling at a high rate of speed. These machines are inherently capable of developing high voltages directly, operating with an extremely high efficiency, and showing promise of attaining a compactness comparable with present electromagnetic machinery. The first experimental vacuum-electrostatic motor, which was also made to function as a generator, operated on 75 kv. alternating-current with an efficiency of 99 percent. A direct-current generator designed for 2 kw. of power at 100,000 volts direct current, and physically of the size of a 2 kw. electromagnetic generator, is now awaiting test. Small generators of this type, besides revealing the possibilities and problems of large vacuum-insulated power machinery, may themselves find important immediate application in the production of high-voltage X-rays for therapeutic and industrial use.

This work is believed by many to be one of the most promising fields in electrical engineering and may lead to developments of great importance both in the generation and transmission of high-voltage direct-current power and in the production of high-energy radiation.

COURSE II

A NEW piece of experimental apparatus is now in operation in the basement of the Steam and Hydraulic Laboratory in Building 3. Its purpose is the measurement of the discharge coefficients of metering nozzles which are so generally used in measuring fluid quantities in industrial processes.

Essentially the apparatus consists of a gas-fired superheater, a steam-jacketed approach pipe at the end of which the nozzle is placed and a condenser which reduces the steam to the liquid state for measurement of its quantity. To avoid water fog in the superheated steam the vapor going to and from the superheater passes in counterflow streams through a heat exchanger which raises the level of temperature in the superheater above the temperature before the nozzle and then cools the steam down to the desired temperature by heat transfer to the steam coming in.

Temperatures are measured with copper-constantan thermocouples. Pressures are determined by mercury columns or water columns. For the usual water-filled lines connecting the pressure tap and the manometer, gas-filled lines have been substituted in order to avoid uncertainty caused by waterlegs and capillary effects where the steam and water meet. To insure against steam entering these lines and condensing there, a small flow of CO_2 is passed through them into the steam pipe. The error in pressure measurement caused by the gas flow is small and determinate.

The experimental program now in progress includes a study of the rounded-entrance metering nozzle through a wide range of compresibility and through the transition from viscous to turbulent flow. It will be fitted into a national program of fluid meters research which is now being planned by the Fluid Meters Committee of the American Society of Mechanical Engineers. The work at M.I.T. is a project of the Mechanical Engineering Department and is under the supervision of Professor Keenan.

COURSE V

AMONG the subjects being investigated at present in the Research Laboratory of Inorganic Chemistry, the following may be mentioned:

The preparation of halogen substitution products of the boron hydrides, in the course of a general study of boron chain compounds. Dr. E. Lee Gamble, in the course of this work, has constructed an elaborate apparatus for carrying out the fractionation of volatile compounds, based upon that employed by A. Stock in his researches upon the hydrides of silicon and boron.

Prof. R. C. Young is continuing his study of the chemistry of thorium with a view toward the preparation of lower valence compounds. Incidental to this work he has determined the composition and the decomposition pressures of the ammines of thorium bromide. A check-up is also being made of the halides of rhenium, concerning which the literature is conflicting.

The organo-metallic compounds of indium are being studied as well as the analytical methods of determination of zirconium and selenium. Professor Blanchard continues his investigations of the carbonyls and nitroso-carbonyls of metals.

A further study is being made of the effect of the electrodeless discharge upon reactions between gaseous substances at low pressures, with the assistance of a new and improved oscillator. With the help of a new magnetostriction oscillator, now practically completed, this Laboratory will have at its disposal oscillators furnishing any desired frequency over the range 50 to 30,000 meters, thus including the ultrasonic region. A further study of the effect of sound energy upon chemical change will now be undertaken.

COURSE III

IN order that the petroleum industry may function smoothly it is necessary to have a large stock of crude oil in storage at all times; the law of capture makes it sometimes necessary to produce oil in excess of current needs. This stock of oil, at times exceeding 300 million barrels, is usually stored in steel tanks at a cost of approximately 35 cents per barrel per year. As a means of reducing the deterioration and loss of oil in storage due to evaporation and, at the same time, remove the hazard of fire, research is being carried on to determine the feasibility of storing this petroleum underground in oil reservoir rocks from which the original oil has been extracted. For this experiment a partially depleted field in California was selected. The wells in this field were inspected and repaired so that there would not be any leakage of gas and oil, either between the walls of the well and the casing or through the valves of the well-head. The next step was to provide a source of energy to convey the oil in the reservoir rock to the well, practically all of the previous supply of energy having been used in conveying the original oil in this reservoir to the surface. To supply this energy large volumes of natural gas were pumped into the reservoir and then petroleum and natural gas were pumped into the formation. Pump pressures in excess of 1000 pounds per square inch were required for this work.

Up to the present time about 750,000 barrels of oil have been placed in this underground storage. When wells have been opened the oil flowed from them at a rate in excess of the original rate of production, indicating that the stored oil will be recovered. In this underground storage there will be no evaporation losses, the cost due to depreciation of equipment is negligible, the fire hazard is trivial and the operating cost is small. It is estimated that if three-fourths of the oil can be recovered the storage expense will be less than if steel tanks had been used.

HOBBIES

(*Continued from page 90*)

Some hobbies should, of course, be carried to the point of making a perfect joint; for even most technical men work under such pressure that they seldom do even a small thing as well and completely as they would like to. Plain time-fillers, except as an excuse for sitting still and thinking, are hardly satisfying, but in the latter role they have a place. The whittler doesn't even have to reply to questions if he is gazing intently enough at his whittling.

A proper selection of hobbies should include lone hobbies and those which can be shared: lone ones, in order that one may always be content when alone, and shared ones in order that one may not spend all one's evenings in the cellar. Then, too, there ought to be short-period hobbies—those that can be taken up and dropped; and finally, (selected from these) those which will persist indefinitely; for it is a terrible thing to have no back-log of interest to drop back onto when the main job goes badly or ends.

Are hobbies expensive? Some of them certainly are. More yachts have been wrecked by budgets than by storms. Jim Brady's passion for diamond collecting was hardly inexpensive, although in the early stages it was a sales stunt rather than a hobby and he made it pay. But the variation in cost is enormous and bears little correlation to interest. A man is just as likely to have a penchant for playing the harmonica as the harp. There seems to be as much lure to the collection of old bottles as of old masters. Some of the best of hobbies cost almost nothing, for they involve the construction of the means of operation.

It seems that many of the very best are overlooked. I propose, for example, archery, either in the field or at the target, where the participants make their own gear. There is some of this, but it is not nearly exhausted as a hobby and as a sport. Archery is a grand field, anyway, although target shooting always bored me stiff. But the long bow is a real hard-hitting weapon, with all sorts of dynamics, ballistics, and strengths of material involved in an intriguing manner that eludes analysis, so that experience and judgment on hazy premises have full sway.

To build a bow that would shoot an arrow clean through a deer and out the other side, even if one has not the slightest intention of disturbing the peace of the race of deer, has a real thrill in it. It somehow takes one back to the primitive and shakes off for a moment the cloying artificialities of civilization; and that, incidentally, is what some hobbies are for. Lots of people cannot stand civilization in too prolonged doses, so they take to the woods. If they would take a home-built bow with them it would help. What grand sport it would be if all firearms were banned in hunting! There would be plenty of game and lots of hunters, and little damage done. But that can come only in the Utopia where there is no trout fishing except with dry flies. For the present we shall have to go on letting the country boy hoist out the big ones with worms. The people who comment on this subject most frequently are the cartoonists. They don't seem to understand that any moron can catch trout on worms.

Nearly every worthwhile hobby has in it the element of self-instruction, and therein lies much of the fun. Some people are so constructed that they can enjoy doing the same thing equally badly all the time, but they are rare. Such ones as exist usually take to golf, so that the rest of the hobbies are relieved of their attention. For most of the race, however, the perfection of a technique, whether of picture-taking, wood-carving, or boat building, holds a fascination, because people generally like to learn perfectly useless things.

Just why is a mystery. It has little do to with brain development and the inheritance of acquired characters, for it is just as intense in those to whom this subject is not personally important. Why try to analyze it? It is as primitive as the pleasure of the sensation of playing in the ocean on a hot day. Nearly every one receives an uplift from the thought that he is progressing in knowledge, even if it concerns something entirely foreign to his everyday affairs; as, for example, the proper filing of a saw.

It is strange, in view of this situation, that there are so few good hobby books. Some there are, such as Elmer's "Archery", but most of them are inordinately insipid. The explanation may be found in the fact that those who really know are not interested in writing for the sake of making money, for money-making spoils any hobby; and they can't afford to publish any other way.

Take wood-carving as an example. Where is there a really good book on the subject—one that goes into the why in an accurate, complete manner, as well as the how? It took me 30 years to learn to sharpen a chisel properly. Lots of people know how, but it never happened that when I wanted to sharpen a chisel there was one of these close by. Books? They gave me angles without the slightest reason why they were chosen, and the steel of chisels was just steel to them. And they are just as bad on every other sort of tool.

Where are the properties of wood gathered? I do not mean the structural properties alone, but hardness really technically specified, change of dimensions as a function of moisture-content, costs, sources of supply, finishing properties, ability to hold paint, resistance to rot under various circumstances, and a host of other things. Kepler's "Camping and Woodcraft" was written about an entirely different subject, yet it

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HOBBIES

(*Continued from page 105*)

comes the closest to what I have in mind of anything I know.

Why do not the sellers of wood cater to this market of those millions who are interested in doing things with wood? Probably for the same reason that automobiles are all sold in much the same way, and to the same public; because the selling fraternity, little as they would admit it, are hidebound with tradition and preconceived notions. Perhaps some day some one will make a hobby of writing books for hobbyists. To make a success, he will have to assume a mental age on the part of his readers in excess of twelve years, for lobbyists are keen individuals.

Some hobbies come and go, like the games of children, urged on by those who are commercially interested. Such was the burnt wood furore, with little gadgets for heating a pointed tool by means of internal alcohol combustion. Perhaps this will come back now that someone has built a metamorphosed electric soldering-iron for the purpose.

These are the hobbies to avoid, unless one is so gregarious that he gets the greatest kick out of a hobby by joining clubs. For every one of these that crowds pursue there are dozens that appear to be completely overlooked. Probably if I name some that to me appear to be ignored, it is simply because I seldom encounter the existing devotees. Amateur glass-blowing, the painting of transparencies, ultra-slow movies of unfolding plants, amateur geological study and prospecting, the building of better kites, all seem to me to warrant attention.

Let us examine just one of these more at length. There is desultory kite-flying by youngsters, and some use of kites in scientific work for lifting instruments. But one does not need to fly store kites, or go after altitude records, in order to find pleasure in kite-flying.

How about a kite to attain maximum angles on a short line? Or a kite that automatically adapts to maintain constant lift with variable wind? A rubber band in the sling will make a kite do interesting things. But the subject is not exhausted. The wing-sections of kites have possibilities. The stability problem would tax the best of aerodynamic analysis, especially in puffy winds, but it will also exercise the empirical approach as well.

The old standard hobbies—reading detective stories, contract bridge, baseball fandom—suffer, at best, from overcrowding. One has to acquire an entire jargon and technique to even belong. Of course, some people like to just read a book, or play a game, or watch one; but the real fan frowns on such hangers-on. It is much more cheering to putter away at some diversion where there may be unique aspects, and there is no high priesthood.

Established critics are a nuisance in connection with any hobby. They usually assume that the aim of the hobbyist is to conform to some established practice. So it is well to seek hobbies in domains in which the critics are not on the throne, or in which they are essentially humble men, such as blacksmiths, cabinetmakers, or pottery makers. Wherever the product is personally enjoyable, the critics are partly circumvented.

Horticulture has a thousand aspects, a range of alleys and paths that have never been entered. Just making something grow, unless one was raised on a farm—and sometimes even then—has a universal appeal. Plant propagation, with its apparent inconsistencies and its startling ramifications, warrants all the attention it will ever get; and no group will ever reduce it to accepted forms. The only difficulty is that, to practice horticulture, one must be reasonably fixed in location.

Some of the finest hobbies are those which fulfill boyhood ambitions, even though in somewhat indirect manner. Most normal youngsters, for example, when they see a blacksmith (provided today they ever do see one) itch to beat out white-hot iron on an anvil. Why not, even many years after, have the thrill of watching the sparks spout under the hammer? The thrill is still there; it has not been dulled by the years, simply kept dormant and ready to spring into life.

Thus there are thousands of hobbies, and almost as many reasons for pursuing them. And the technical man is particularly fortunate, for he can enter upon many sorts fully equipped to make early progress into portions that are full of satisfaction.

Do not think that a reasonable amount of hobby time is wasted. Some of the happiest hours of life are thus spent, and it is well worth while to be happy in this life. This is not merely because a happy man works better at his regular job, although he does. Rather it is because the joy of individual accomplishment is a worthy end in itself. There can not be too much of this kind of joy in the world, and he who participates and exemplifies accomplishment in his hobbies adds thereby directly to the sum total of social sanity.

There is no doubt whatever that, with modern technique, and in the long run, this world of ours will be materially prosperous. There is much greater question whether it will be a sane world, capable of reasonably employing its possibilities. The hobbyist, if he proceeds with moderation and never lets his hobbies triumph over his main life work, is likely to be a saner man because of his hobbies. The world needs saner men.

Finally, the ideal of the true hobbyist is not a chamber of horrors, in which brash dogmatists and bungling image-makers set up monstrosities of contradiction which defy alike the laws of nature and of man. Let us pray that our hobbies, at least, may escape the vandalism of administrative manipulation that has made of more than one experiment in "planned economy," an object to evoke a shudder or a grin. Let us preserve our hobbies, if nothing else, from the boondogglers.

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COTTON

(*Continued from page 99*)

Highway Department used cotton mats, of seven different designs and weights, 47 times on three different projects. In each case, the mats remained at a placement and were kept dripping wet for a minimum of 72 hours. At the end of the third project the condition of the mats was such as to justify the estimate that cotton mats will stand at least 50 placements. They cost no more than other methods and the concrete is more evenly cured as a film of water is held over the entire surface of the pavement, whereas with wet earth or straw there is no way of determining whether certain portions have dried out. It also keeps the top-surface clean in case a bituminous topping is to be used, when the adhesion will be much better.

"Cotton houses" have attracted wide interest among architects and builders of low-cost rural and industrial homes. The first experimental project was completed last summer at Northport, Long Island, by a prominent architect, Mr. Lawrence Kocher, in cooperation with the Institute, to establish the practicability of applying cotton duck as an outside wall surface covering.

The flexibility of the cotton fabric which makes for ease of application and therefore, economy in building costs, also gives the house a distinctly modern appearance of pleasing lines due to the rounded corners and flat wall surfaces.

Another use for cotton has been found in "cotton overcoats" for railroad switch mechanisms. Investigations of a tie-up of one railroad system this winter disclosed that the switches had frozen and that the heating devices, placed at intervals along the tracks to protect the switches, were also useless due to high winds and heavy snows. As a result, canvas covers, each 2⅓ feet wide and approximately 12 feet long, were installed over heating units at key points.

It has been found that one of these canvas-protected units, as long as its electrical connections remain unimpaired, will do the work of two men working with hand brooms.

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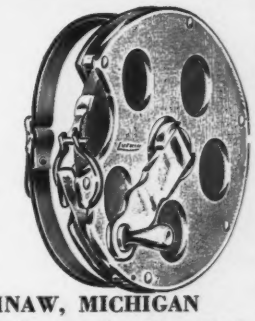

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CHROMIUM – PAST AND PRESENT

(*Continued from page 95*)

1869 the Chrome Steel Works commenced operation in Brooklyn, New York. Their production went largely into plate for the manufacture of burglar-proof safes, mining machinery parts and other similar uses. At about the same time the first alloy steel bridge was being constructed over the Mississippi River. This bridge, built by the famous Captain Eads, was constructed with the principal load-carrying members of chromium steel.

In spite of the fact that the value of chromium steel was recognized at this early date, it is only within the past few years that these steels have become used extensively. Except for the use of chromium in armor plate, which was developed in the nineties, and for the advent of high speed steel at the turn of the century which added another small but exceedingly important use for chromium, the utilization of the chromium steels was quite small until the period of the automobile. Automotive engineers have always been in the forefront of all metallurgical developments and it is natural that they immediately made use of the superior chromium steels. The production of large amounts of chromium steels dates, therefore, from about 1910 when the automotive industry had grown sufficiently to require special material in fairly large quantities.

Development of steels of the S.A.E. type was rapid. The varieties were quite numerous and chromium was certainly one of the major elements in their composition. In this connection chromium in addition to creating simple steels of superior properties has turned out to be "a good mixer", a quality equally valuable in metallurgy and in human relations. That is, when used with many other alloying metals it not only contributes its own share to enhance the steel quality but also complements and increases the effect of the other alloying metal. From the automobile industry, the use of this class of steel spread to many other industries such as machine tool and farm implement parts and many others. The use of such steels has continued up to the present, the analysis of the steels being very little different from those of the earlier part of the period. A great deal has been learned in the last few years concerning the proper balancing of the analyses, methods of heat-treatment and proper fabrication, until today the application and use of these steels is well understood by a very large number of competent metallurgists. Ranging from the high-carbon plain chromium ball bearing steels, to the chrome-vanadium spring steels, the chromium-nickel, and chromium-molbydenum varieties so useful for shafting, gears and other high duty parts, to the low carbon easy machining carburizing steels, a variety of chromium steels can be found to meet every need. To all of these steels, chromium contributes the property of ready response to heat-treatment, uniform hardening throughout the section, fine grain size, as well as high strength and elastic limit, coupled with toughness, a high fatigue value, resistance to shock and ability to withstand wear.

During the latter part of the present era, chromium took a new leading position through the advent of the stainless steels. There is no doubt that these steels would have made their appearance in commercially important tonnage at some earlier date had not the turmoil of the war years prevented all new endeavors of this type. It is a curious and interesting fact that simultaneously and entirely independently, stainless steels were developed in three countries. In each country the development proceeded along lines most important to the industry of that particular country.

Brearley in England, working in the atmosphere of the Sheffield Cutlery Mills, developed that variety of stainless steel adapted to cutlery use, although his initial work, which led him to the discovery, was on steels suitable for gun linings. Strauss in Germany, invented that chromium-nickel variety of stainless steel peculiarly adapted to resist chemical corrosion and to fabricate easily, while Haynes, in the United States, developed stainless iron.

Elaboration of the many varieties and uses of stainless steels will not be attempted here. (See "Defeating the Rust Racket with Stainless Steel", THE TECH ENGINEERING NEWS, November, 1934). It suffices to say that their resistance to corrosion is today playing an enormous part in the chemical and food industries. Their resistance to oxidation and their ability to maintain strength at high temperatures has opened new roads for progress to chemical engineers in the oil cracking and similar fields and to the furnace builder. Their permanence of surface and pleasing appearance has led to wide application in architectural and decorative fields.

There is one phase of these stainless steels which is of sufficient importance to influence their future growth so greatly as to warrant frequent repetition. Very often, thinking and speaking of stainless steels, the idea of bright surface and pleasing appearance or of resistance to acid and other chemicals is uppermost. However, very probably one of the chief roles of the stainless steels of the future will be to enable the engineer to use higher design strengths and a lower factor of safety and hence obtain lighter structures than has been practical hitherto. Other steels can be given equal or higher physical properties than the stainless steels. However, if the engineer were to design on these high strengths, the structure would lack permanence through the attack of one man's worst enemies — rust. With the assurance of greater permanence which the high chromium steels give, the engineer is now in a position to use high design-strengths and minimum factors of safety with an assurance that the cross-section of steel figured on will be there when the need comes for it to carry its design load.

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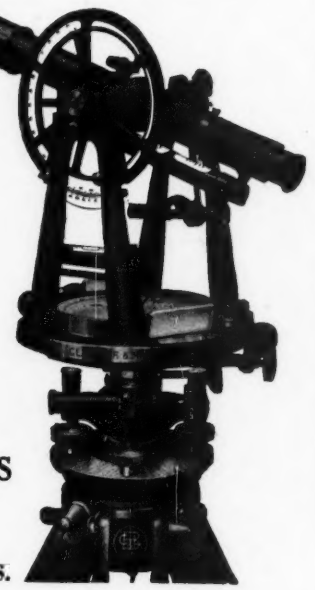

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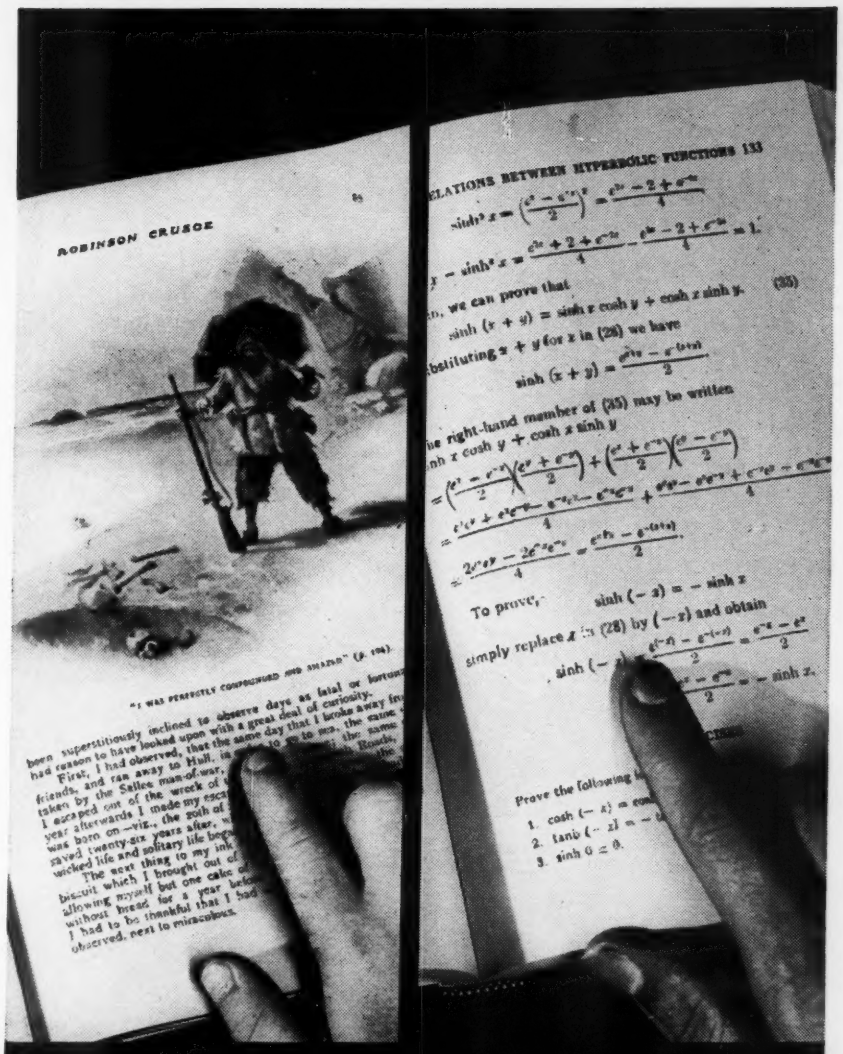

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